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Geology of the Eastern Part of Baird Township

District of Kenora

By
STEWART A. FERGUSON

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GEOLOGICAL MAPS AND CHARTS
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Map No. 2072 (coloured)—Eastern Part of Baird Township, District of Kenora. Scale, 1 inch to 1,000 feet.

Chart A—Subsurface Plan No. 1, Southeast Quarter of Baird Township, showing geology of the 950-foot level, Madsen Red Lake mine, and the 800-foot level, Starratt Nickel mine. Scale, 1 inch to 1,000 feet.

Chart B—Subsurface Plan No. 2, Southeast Quarter of Baird Township, showing geology of the 1,900-foot level, Madsen Red Lake mine, and the 1,960-foot level, Starratt Nickel mine, longitudinal projections of ore zones and four geological cross-sections. Scale, 1 inch to 1,000 feet.

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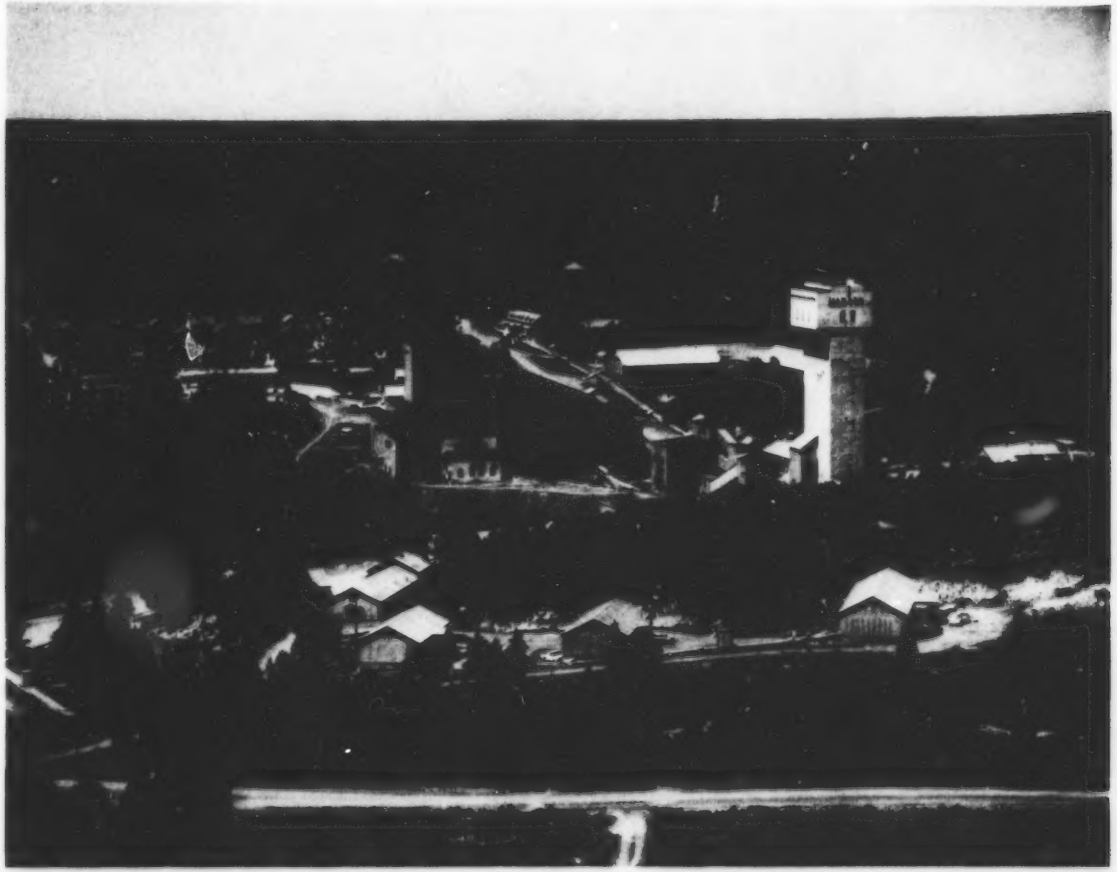
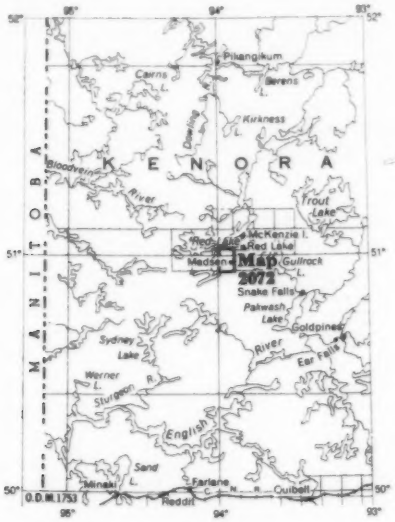


Madsen Red Lake Gold Mines Limited, showing the mill, headframe, part of the townsite, with Russet Lake beyond the buildings.

ABSTRACT

The geology, structure, and mineral deposits in the eastern part of Baird township are discussed in this report. The map-area forms the southwestern part of the Red Lake area where substantial mineral production has been attained.



Key map showing location of the Baird township map-area. Scale, 1 inch to 50 miles.

The oldest group of country rocks are metabasalts overlain by a thick unit of welded tuff. Tuff beds containing ore zones are interbedded with the major rock units at and near the contact. Intrusive rocks range from serpentinite, hornblendite to metagabbro, and granodiorite, diorite and late dikes of metagabbro and porphyritic metagabbro. The Killala-Baird batholith and the Faulkenham Lake stock are the major granitic intrusions.

The axial trends in the older rocks of the northwestern part of the map-area are in a northwest direction, but the trends in the younger rocks in the southern part are almost at right-angles to this direction. Near the contact the older rocks swing into conformity in dip and strike with the overlying group.

Gold deposits occur within the area as veins and also as mineralized zones within tuff beds. Production of gold from the Starratt Nickel mine and from Madsen Red Lake Gold mine has been from this latter type of occurrence.

Geology of the Eastern Part of Baird Township

By

Stewart A. Ferguson[1]

INTRODUCTION

Baird township is in the Red Lake area, and the east boundary of the township is 3½ miles west of the settlement of Red Lake. One gold mine is in production at the present time, and an adjacent mine is no longer producing, although the mill at the property was in use for the treatment of ore trucked from H. G. Young Mines from September 1960 until February 1963. The centres of population are at the Madsen townsite and the Starratt townsite, with a few additional dwellings near the bay at the outlet of Flat Lake. There are no other permanent residences in the township, but the northeastern part of the map-area is part of the municipal district of the Corporation of the Township of Red Lake.

Of the six gold mines presently in production near Red Lake, one of the producers, Madsen Red Lake Gold Mines Limited, is within Baird township. This mine has been in continuous production since 1938. Starratt Nickel Mines Limited, formerly called Starratt Olsen Mines Limited, was in production from 1948–56. To the end of 1962 the two mines have milled 6,430,342 tons of ore and produced 1,791,926 ounces of gold and 345,121 ounces of silver, valued at $63,411,407. From 1938 until the end of 1962 the Madsen dividends amounted to $8,677,629.

At two other properties, New Faulkenham Mines Limited and Redaurum Red Lake Gold Mines Limited, a shaft was sunk and underground workings established, but no ore has been produced.

Scope of Map and Report

Since 1959, remapping of parts of the Red Lake area adjacent to the producing mines has been in progress by field parties led by the author. Mapping of the eastern part of Baird township was completed during the field season of 1962.

The basemap, at a scale of 1 inch to 1,000 feet, was compiled by the staff of the Cartographic Unit of the Ontario Department of Mines using the original field notes of the township survey, the surveys of individual claims, power-line surveys, and the survey of the highway by the Ontario Department of Highways Shore lines and other topographic features were obtained from air photographs taken in 1951 for the Forest Resources Inventory of the Ontario Department of Lands and Forests.

[1]Geologist, Ontario Department of Mines, Toronto.

Parts of the township lines, some surveyed claim lines, and lines cut previously for geological and geophysical surveys were reopened and chainage pickets established at 200-foot intervals. Compass-and-chain surveys were made of the bush roads and trails, and these surveys were tied to the claim or township surveys. These surveys provided control for geological and magnetic traverses. Geological traverses were made at an interval of 600 feet, or less, except in the area immediately adjacent to the mining properties covered by Ontario Department of Mines Map No. 49f. Within the area covered by this map the outcrops shown were used, supplemented by more recent company information, and only a few traverses were made to check the rock types. Magnetic traverses were mainly restricted to areas of little outcrop where aeromagnetic maps had indicated the existence of strongly magnetic rocks. Both geological and geophysical traverse lines were made by chain-and-compass methods between established survey positions or between a shoreline and survey line.

On the township's north boundary, the cornerpost and milepost 1 fall within St. Paul Bay. Milepost 2 was not located, but milepost 3 is in position. No mileposts were located on the township's east boundary. The southeast cornerpost of the township is in place as well as mileposts 5, 4, and 3, along the south boundary. In addition many surveyed claim lines are open so that they can be followed and the cornerposts located.

Acknowledgments

Information supplied by mining companies has been most helpful. Such information includes geological and geophysical maps and reports, diamond-drill logs and drilling plans, and underground plans and sections. Information on certain properties was obtained from the files of the resident geologist, Ontario Department of Mines at Kenora. The geology of Humlin Red Lake Mines Limited in Fairlie township was taken from a geological map supplied by B. W. Lang, and the geology of the area west of the New Mallen Red Lake property was taken from a map filed as assessment work by Riverdale Gold Mines. An aeromagnetic map of the eastern part of Baird township with magnetic data at low altitude and closely-spaced traverses was also supplied by B. W. Lang on behalf of Mespi Mines Limited. The figures for production used with this report were obtained from T. J. Kelly, Statistician, Ontario Department of Mines.

During the field season of 1962, F. A. Fell arranged that members of the field party have the use of an office, facilities in the dry, and a printing service at Dickenson Mines Limited. Leo Goldsmith allowed the party to use drafting tables and stools, which are the property of Abino Gold Mines Limited. Ross Williams of the Ontario Department of Lands and Forests arranged for the storage of canoes during the winter months. On some occasions Charles Culbert of the Mine Rescue station at Red Lake transported the party by boat to their field camp at the Humlin Red Lake Mines property in Fairlie township.

F. G. Harriman co-operated with the author in supplying information and in writing part of the property description of Madsen Red Lake Gold Mines Limited. Alexander Watt of McKenzie Red Lake Gold Mines Limited spent one day with the author visiting points of geological interest. J. E. Collins, S. Check, and G. G. Beacom served as field assistants during the field season, and D. K. Draper and W. Culbert served as field assistants during part of the field season. As senior assistant, J. E. Collins was responsible for some of the mapping.

Means of Access

Highway No. 618, which is hard-surfaced, enters the township from the east and extends for about 2 miles to the Starratt Nickel Mines property. On the Madsen property secondary roads lead to the townsite, the shore of Russet Lake, the gravel pit, to the explosives storage buildings, and to Flat Lake. A truck road leads from Starratt townsite to the shaft at New Faulkenham Mines and continues to the south boundary of the township. A bush road leaves the secondary road near the south side of the bay at the outlet of Flat Lake and after crossing the creek follows the east shore of the lake, and continues to an unnamed lake to the northwest and beyond the lake to the edge of the area mapped. A wagon road, now partly overgrown, was used to transport supplies from St. Paul Bay to the camps and shaft on the Redaurum property.

St. Paul Bay in the northeastern part of the township may be reached by boat from Red Lake. Flat Lake and Russet Lake as well as the connecting creek are navigable for small boats. A portage about 1,000 feet long provides a travel route from the northern part of Russet Lake to the creek flowing into the next lake along the drainage system.

From the roads already mentioned and from the shores of the lakes a network of trails leads to High Lake, to the southeastern part of the map-area, to the New Mallen Red Lake property, from the north end of Flat Lake by a circuitous route to the north end of Russet Lake, and across the Redaurum and Parvus properties. From the shores of Red Lake at the Humlin and Redruth properties in Fairlie township, trails provide access to the northern part of Baird township.

Previous Geological Work

Previous geological work in the area by government geologists have been described in a number of reports (Bell 1885, p. 5; Dowling 1896, pp. 45–50; Bruce 1924, pp. 12–39; Bruce and Hawley 1928, pp. 1–72; Hurst 1936, pp. 1–52; Horwood 1945).

A number of geological reports and diamond-drill logs, and one geophysical report have been submitted to the Ontario Department of Mines as assessment work. These reports as well as the information collected by staff geologists of the Ontario Department of Mines comprise the files of the companies, which are shown in the accompanying table:

Company	Type of Information	Toronto File	Kenora File
Childs Red Lake Gold Mines Ltd.	Geological	———	R.L.5
New Faulkenham Mines Ltd.	Geological	———	R.L.5
Parvus Mines Ltd.	Geological	———	R.L.5
Redaurum Red Lake Gold Mines Ltd.	Geological	———	R.L.5
Redruth Gold Mines Ltd.	Geological	———	R.L.5
Riverdale Gold Mines Ltd.	Geological and geophysical	63.117	R.L.5
Starratt Nickel Mines Ltd.	Geological	———	R.L.5

Topography and Drainage

The waters of St. Paul Bay, which is a part of Red Lake, occupy that part of Baird township adjacent to the northeast cornerpost. Beaverdam Lake near the Madsen No. 2 shaft empties toward the southwest, but immediately north of

the shaft the drainage is to the northeast. Much of the southern part of the township drains by a series of creeks, ponds, and small lakes into Flat Lake. The southern arm of this lake is very shallow and in late summer is partly overgrown with reeds adjacent to the shoreline and the small delta of tailings. Flat Lake is only slightly higher than Russet Lake into which it empties. The waters discharged from Russet Lake form the major creek of the township and flow northwards to St. Paul Bay. All the larger tributaries of this creek come from the west, and along its course this creek is interrupted by one expansion into a lake and by several beaver ponds. The northwestern part of the area drains by several small creeks flowing directly into Red Lake. Faulkenham Lake receives the discharge of High Lake, which in turn is supplied with water from two smaller lakes. Near the southeast corner one small creek flowing from an unnamed lake flows southwestwards to Roger Lake on the township boundary.

The highest part of the map-area is believed to be a ridge near the east boundary of the township between milepost 3 and the power line leading to the Madsen property. This ridge continues southwest passing to the south of Flat Lake. From this locality another branch of the ridge extends east to the south end of Faulkenham Lake. The east shore of Russet Lake and the northwest shore of Faulkenham Lake are generally steep. The relief over much of the area is about 50 feet rising to 100 feet in the vicinity of the larger ridges.

Outcrop is abundant on the main ridges and is well exposed on these ridges and along shorelines; elsewhere, outcrop is not so abundant and not so well exposed. The largest and best exposed outcrops are on the ridges where the strike of the rocks and the direction of glacial movement are nearly parallel. Where the trend of the rocks and the direction of glacial movement are at a large angle, the outcrops are elongated in the direction of glacial movement.

In the southern part of the map-area the dikes appear to weather more quickly than the country rocks. These dikes tend to occur near the edges of the outcrop, and some of the smaller lakes are partly underlain by dikes. The creek flowing from Russet Lake follows a belt of easily eroded, serpentinized rocks for part of its length, and the south shoreline of St. Paul Bay may also be partially controlled by the presence of a band of serpentinized rocks.

Natural Resources

The major bush roads and trails were probably first developed as haulage roads for supplies of jackpine and spruce used by the mines. The only road that has been recently used for this purpose is the one near the northeast shore of Flat Lake, but the major areas of recent cutting are farther west than the area mapped. Most of the eastern part of the township is covered with small second-growth spruce in the lower areas and by jackpine and poplar in the higher areas. An irregular area of burn, estimated to be about five years old, extends northwest of Flat Lake on either side of the bush road leading to the northwest.

Beaver are very active as shown by the large number of dams maintained in good condition. Larger game animals such as deer and moose exist in small numbers. Pike and pickerel are also present in the lakes.

GENERAL GEOLOGY

The country rocks in the map-area consist of two main units of Precambrian rocks. Major granitic intrusions, which occur partly within the township, are the Killala-Baird batholith, the Faulkenham Lake stock, and possibly a small part of the Dome stock. Basic and ultrabasic rocks are dikes or sills and plutons. Acidic dikes consist of granodiorite and quartz-feldspar porphyry.

TABLE OF FORMATIONS

CENOZOIC

RECENT: Peat, tailings, sand.

PLEISTOCENE: Sand, gravel.

Great Unconformity

PRECAMBRIAN

INTRUSIVE ROCKS: Porphyritic metagabbro ("turkey-track"), metagabbro, quartz-feldspar porphyry, sericitized quartz porphyry, granodiorite, diorite, metagabbro, hornblendite, serpentinite, tremolite-talc schist.

Intrusive Contact

ACID TO INTERMEDIATE METAVOLCANICS: Porphyritic quartz latite, fine-grained quartz latite, latite breccia, porphyritic latite containing over 10 percent mafic minerals ("Howey diorite"), tuff beds.

BASIC TO INTERMEDIATE METAVOLCANICS: Pillowed basalt, flow-top breccia, variolitic basalt, uniform basalt, tuff beds, chert and lean iron formation.

Precambrian

Basic to Intermediate Metavolcanics

Three major stratigraphic rock units are present in the Red Lake area, but only the lower two units are found in Baird township. The oldest rock group consists of basalt (metabasalt) overlain by a welded tuff unit consisting mainly of latite with a few interbedded basaltic flows.

The last departmental geologist (Horwood 1945, pp. 17–18), to report on the rocks of the Red Lake area, divided the rocks into an older Keewatin group consisting of basic lavas with a few outcrops of rhyolite and an overlying Timiskaming sedimentary group. The change from a two-unit to a three-unit stratigraphic division has been accomplished mainly by subtracting a thick unit from the base of Horwood's upper group, as well as the inclusion in this group, of rocks formerly mapped as porphyry, hybrid granodiorite, Howey diorite, and metamorphosed and granitized rocks.

Little direct evidence of the relations of the two major groups was obtained from the surface mapping. Generally the dips are fairly steep and the facings of beds so few that no strong case may be made to establish the relative age relations from surface mapping within this township. The age relations between the groups has been well established by mapping in adjacent townships, supplemented by information from underground workings in Baird and other townships.

BASIC METAVOLCANICS

All the darker-coloured flows are included within this group. Partial analyses of a group of these rocks from Bateman township (Ferguson 1962, p. 7) gave an average silica content of 44.8 percent, which is about 3 percent below the

silica content of the average basalt and more than 9 percent below the average silica content for andesite. A rock specimen collected by Gummer (1941, pp. 649–50) on the eastern point of the island on claim K.R.L.11762, Fairlie township, was described as "typical volcanic: a fine-grained rock of dioritic aspect." An analysis of this rock by Gummer gives the silica content as 48.4 percent, but the author considers the rock to be a dioritic phase of the Dome stock.

The basalt weathers to a greenish grey colour and generally is fine-grained. Pillowed phases are associated with the uniform basalt. The pillows range in size from 1½ to 3 feet and display a variety of shapes in plan and section. Amygdules of carbonate and chlorite are found adjacent to the pillow margins. On claim K.R.L.12963 in the northern part of the Starratt Nickel property, lenses of white chert up to an inch in width occur as interpillow material. On the outcrop near the southwest corner of claim K.R.L.12522 on the Madsen property, similar interpillow material occurs, but at this locality it is more argillaceous.

The flow-top material generally contains abundant, small, angular fragments from ½ to 1 inch in diameter in a matrix that is slightly rusty at many occurrences due to the weathering of a small amount of pyrite or carbonate. To the north of Flat Lake on claims K.R.L.19427, 18778, and 18729, the flow-top material consists of irregular blebs and thin laminae of light buff-coloured material in a darker-coloured matrix. This alternation of colour produces a strikingly banded rock.

No coarser-grained parts of flows have been recognized. As intrusive metagabbro of similar appearance and grain-size is widespread, these rocks are all included as metagabbro.

Thin sections of these rocks from the Madsen mine have been described by Butler (1955, p. 57), and Hawley (1946, p. 6) has described thin sections from the Starratt Nickel mine. The average composition of these rocks is given as about 50 percent plagioclase and 30–40 percent of the amphiboles, tremolite, and hornblende. Other minerals, which are present in small amounts, are chlorite, quartz, magnetite, epidote, and tourmaline, as well as stringers of calcite. Biotite is disseminated throughout in small amounts, and the amount of chlorite present varies considerably.

Variolitic Basalt

Variolitic basalt has been observed on claims K.R.L.13063 and 13080 in the northeastern part of the Redaurum property. This basalt is pillowed and contains the light-coloured variolites developed in a zone about 3 inches wide adjacent to the pillow margins. The variolites are from round to oval in cross-section and ⅛–¼ inch in diameter.

Metamorphism of Basic Metavolcanics

No metamorphism or recrystallization was observed that could be related to the proximity of intrusive rocks such as the Killala-Baird batholith or the larger masses of metagabbro. Many of the specimens, for which thin-section descriptions are available, are close to mineralized zones and show variable amounts of hydrothermal alteration.

Lean Iron Formation

Lean iron formation and banded cherts are the only widespread interflow sedimentary rocks. The most persistent bands occur on claims K.1537 and K.R.L.13081 of the Redaurum property, where two generally parallel bands persist for a strike length of about 500 feet. These bands range in thickness from a few feet to 15 feet or even greater widths where the bands are presumably thickened by folding. A lens of iron formation about 10 feet wide is well exposed on an outcrop ridge on claim K.R.L.19684 of the Aiken property. On the Redruth property narrow lenses of lean iron formation are exposed in pits on claim K.R.L.18486 and on claim K.R.L.1612 of the Aiken property. These iron formations partly consist of finely laminated bands of grey chert as well as chert interbanded with magnetite or pyrite. Weathering of the pyrite on the Redaurum property has produced rusty alteration zones.

Acid to Intermediate Metavolcanics

TUFF BEDS

These rocks occur mainly in a zone extending northeast from near the south end of Flat Lake to Beaverdam Lake and farther northeast to the township boundary. The best-known and most persistent bed is along the contact between the basaltic lavas and the overlying welded tuff unit. Other tuff beds are interbedded with the basaltic lavas, and a few tuffs are reported from drilling within the welded tuff unit. The tuff bed at the contact is called the Austin tuff at Madsen, and has been traced by outcrops and drilling for a strike length of 2½ miles on this property. The same bed, which is called the South tuff at Starratt Nickel mines, has been followed by surface drilling and underground workings for an additional mile to the southwest. At the Madsen the McVeigh tuff is adjacent to the Austin tuff and is known to persist for a length of 4,000 feet. On the Starratt Nickel property the North tuff corresponds in position to the McVeigh tuff and also has been traced on surface for about 4,000 feet. Farther to the northwest, on the Starratt Nickel mines property, another tuff bed is called the Creek Zone tuff. These tuff beds persist down the dip without change in thickness to the lowest mine workings of 4,000 feet at Madsen, and 2,000 feet at Starratt Nickel mines. The tuff beds range in thickness from 50 to 600 feet, but generally are about 200 feet.

The tuff ore beds are fine-grained rocks of brownish or greenish colour. Individual bands are less than an inch thick, and an alternating colour banding from brownish to greenish may be present. Some parts of the beds contain angular fragments, which usually are small, but a few are up to several feet in diameter. Some of the fragments are quartz latite similar to the rocks forming the major part of the welded tuff unit. Associated with the tuffaceous material are conformable bodies of sheared latite. Garnets are numerous near the ore zones but rarely are present with the ore.

A thin-section study of the Starratt Nickel tuffs by Hawley (1946, pp. 3, 4, 9–11), and of the Austin tuff by Butler (1955, pp. 39–43), gives the following information. The mineral constituents show a rapid variation across the bedding, and the mineral content of individual beds is clearly related to the original mineral content. The lighter-coloured bands consist of quartz with trains of fine magnetite and scattered grains of biotite, sericite, and zoisite. Other bands consist of tremolite and hornblende (paragasite) as the main

constituents and an associated mosaic of quartz, plagioclase, and sericite. Biotite-rich bands are associated with quartz, garnets, and zoisite. In some coarse-grained sections, skeletal metacrysts of andalusite replace quartz-feldspar bands in biotite schist. The andalusite contains minute inclusions of biotite and iron oxides. Staurolite was present in one section. An older corroded type of garnet occurs, scattered throughout certain beds, and a younger, fresher type is associated with veinlets and with sulphides. A few grains of microcline are associated with the plagioclase, and small amounts of calcite occur in some sections. A little chlorite is associated with biotite. Butler examined four thin sections from the McVeigh tuff and found the mineral assemblage to consist almost entirely of amphibole and biotite.

WELDED TUFF UNIT

The welded tuff occurs in a broad band in the southern part of the township. In the northern part of the map-area one band occurs near the shore of St. Paul Bay and farther to the northwest in Fairlie township. Other bands are present on the Parvus property and to the east of Russet Lake.

Lapilli tuff from the west side of the township line on Madsen claim K.R.L.12674.

Pillow lavas interbedded with welded tuff unit, north side of power line, Madsen claim K.R.L.12674

Bedding features are evident in outcrops of lapilli tuff and tuff-breccia beds but not in uniform tuff. However, the persistence of particular rock types along the strike indicates stratification in thick units. A fine-grained uniform tuff with small amounts of associated tuff-breccia extends across the New Faulkenham property and also a part of the New Mallen property. A similar band, about 1,000 feet farther south, persists for 4,000 feet from the east boundary of the township. A porphyritic quartz latite ("porphyry") has been traced across much of the Madsen property in a zone immediately adjacent to the Austin tuff (O.D.M. map No. 49f), and on the New Faulkenham property quartz latite was observed on claims K.R.L.12878, 12881, and 12882. The porphyritic phases contain phenocrysts of feldspar or quartz up to 3 millimetres in diameter.

The rock types within the welded tuff unit range from fine-grained to porphyritic to granitic in texture. In the coarser-grained types the hornblende and biotite content varies from a small amount to as much as 40 percent.

The lapilli tuffs and tuff-breccias form a comparatively small part of the welded tuff unit in Baird township. The tuff-breccia on the New Faulkenham and New Mallen properties contains fine-grained acidic fragments 2–5 inches in diameter, contained in a uniform tuffaceous matrix. Local occurrences of lapilli tuffs have been observed on the Madsen property on claim K.R.L.12674, west of the township line, and in the central part of K.R.L.12659. One of these beds consists of closely packed tabular fragments in parallel orientation. At

the other occurrence the lapilli are light coloured and rounded-to-circular in cross-section and 3–5 millimetres in diameter.

POINT COUNT ANALYSES OF WELDED TUFFS AND "HOWEY DIORITE"

Location or Reference	Plagioclase	Orthoclase	Quartz	Hornblende	Biotite	Chlorite
	percent	percent	percent	percent	percent	percent
New Faulkenham K.R.L.12879	53.8 (An_{10})	20.9	15.5	——	10.4	——
New Faulkenham K.R.L.12881	75.5 (An_{10})	9.8	2.9	——	7.0	2.0
Dome Twp. McManus Red Lake K.1594	71.0 (An_{10})	——	1	7	——	12
Dome Twp. Howey Consolidated K.1414	51.0 (An_{10})	——	33	——	——	14
Horwood (1945) p. 40	53 (An_{50})	——	10	34	5	——
Chisholm (1954) p. 20	60	——	——	25	——	——

The analyses in the accompanying table indicate that the minerals present and the proportions of each are quite variable. The plagioclase in the specimens from the New Faulkenham property is untwinned but has an index less than balsam, so that it is considered to be albite. The orthoclase in these two sections was identified by staining, and occurs in scattered grains and elongated stringy masses associated with albite. Quartz occurs in a fine-grained mosaic and tends to be in bands associated with biotite. Biotite occurs in disseminated flakes and in biotite-rich bands. Banding is produced by the concentration of biotite in certain bands and by the elongation of the masses of orthoclase.

Butler (1955, pp. 63–65, 67) describes the "porphyries" as containing aggregations of relatively large quartz grains. Some of the feldspar phenocrysts that are less altered show microcline twinning. The major constituents are quartz, feldspar, sericite, muscovite, and biotite, and the minor constituents are epidote, carbonate, chlorite, hornblende, tourmaline, magnetite, and sulphides.

In the fragmental rocks the fragments consist of a fine-grained mosaic of albite and biotite, and the matrix consists of albite, biotite, and skeletal crystals of hornblende. A partial analysis of one of the "porphyries" from the Madsen by the Lakefield Technical Institute (Turner 1960, p. 39) gave a silica content of 73.38 percent.

No true rhyolites are present in the rock types examined in thin section, as the ratio of potash feldspar to total feldspar is too low. From the petrographic evidence the rocks are latites with more acidic phases grading into quartz latite and the more basic phases containing higher percentages of mafic minerals.

Interbedded Basalts

Associated with the welded tuff unit and presumably interbedded with it, or overlying it, are some dark-coloured basalts. The band of basalts from 1,500 to 2,500 feet east of the Madsen No. 2 shaft, consists partly of uniform basalt and

partly of pillowed basalt. The pillows on the north side of the power line to the Madsen property are 2–5 feet in diameter with darker-coloured pillow selvages about 1½ inches thick. The interpillow material has weathered more quickly than the pillows to leave a depression about ½ inch wide surrounding each pillow. Parts of the pillows contain amygdules of quartz, which weather in relief.

Intrusive Rocks

METAGABBRO

Some rocks in this group may be the coarser-grained parts of flows, but cannot be distinguished from similar rocks of intrusive origin. Certain metagabbros cut the rocks of the granite batholith and are considered to be younger than the granite. A granodiorite dike cuts the metagabbro on the Madsen claim K.R.L.12524 immediately north of the power line. If this dike is of the same age as the major granitic intrusions, this metagabbro was intruded before the granite. All the metagabbro that is associated with the country rocks is included with this group and probably includes rocks of more than one age and mode of formation.

These rocks are present as dikes or sills or as larger plutonic masses. Small exposures of these rocks are widely distributed throughout the map-area. The largest pluton is on the east side of Russet Lake, and two other smaller plutons are located, one at about 1½, the other 2 miles northwest. Some prominent dikes or sills that are associated with the welded tuff are up to 400 feet wide and extend for 2 miles along the strike from the east boundary of the township.

The finer-grained phases of the metagabbro are greenish rocks with tabular, cream-coloured feldspars from 1 to 2 millimetres in diameter associated with amphibole. The coarser-grained phases are greenish to black and contain abundant amphibole crystals up to 4 millimetres in diameter.

Point Count Analyses of Thin Sections

Location or Reference	Plagioclase	Orthoclase	Quartz	Hornblende	Other
	percent	percent	percent	percent	percent
Aiken Red Lake K.R.L.20587...	25 (An_{32})	——	——	70	leucoxene
Butler (1955) p. 75, diorite.....	40	——	5	45	——
Hawley (1946) p. 6, hornblende diorite.....	50(andesine)	——	——	50	——
Horwood (1945) p. 48, Madsen vicinity.....	25 (An_{30})	5	25	40	2-biotite 3-magnetite
Horwood (1945) p. 48, Howey vicinity.....	30 (An_{30})	——	——	60	5-biotite 5-epidote

The thin section of the specimen from Aiken Red Lake property contained tabular feldspar crystals with carlsbad twinning but with little albite twinning, and the feldspar contains micaceous alteration. Needles of hornblende extended into the feldspar. In these rocks the feldspar present is characteristic of diorites, but diorites do not normally contain more than 40 percent dark minerals. The specimen examined by Horwood from the Madsen vicinity is close to the

diorite classification, but the other rocks are probably metagabbro. Magnetic traverses across exposures of these rocks on Madsen claim K.R.L.12605 indicated a magnetic relief 2,000 gammas above the general magnetic level.

HORNBLENDITE, SERPENTINITE, TREMOLITE-TALC SCHIST

These rocks are found near the north township boundary in the vicinity of St. Paul Bay, on the Parvus Mines property near the east boundary of the township, along the watercourse draining Russet Lake, on the east side of the creek draining Flat Lake into Russet Lake, and on the east shore of Russet Lake. Dikes of these rocks also have been intersected by the underground workings and by drilling at the Madsen and Starratt Nickel properties. Because these rocks weather more rapidly than the adjacent rocks they are poorly exposed, but they have a magnetic relief from 2,000 to 4,000 gammas above the general magnetic level.

The more highly altered phases of these rocks are very soft and of light grey to dark grey colour and appear to be fine-grained. Less altered phases appear to be medium-grained with prominent amphibole crystals about 3 millimetres in length.

A thin-section study of a specimen from claim K.R.L.48899 of the Redaurum property contained an estimated 65 percent talc, 20 percent antigorite, 10 percent carbonate, and 5 percent magnetite. Outlines of olivine, which formerly were enclosed in a pyroxene or amphibole, are preserved by the deposition of magnetite around grain boundaries. The primary ferromagnesian minerals are now completely altered to talc, carbonate, and magnetite. Antigorite occurs in irregular zones and along fractures. Four thin sections of this rock type were examined by Hawley (1946, pp. 6, 7) from specimens taken from underground drillhole U-378 from the Starratt Nickel mine. He reported that the chief constituent was serpentine in felted aggregates associated with fine-iron oxides. Tremolite and talc are inter-grown with the serpentine. Remnants of colourless olivine and either pyroxene or an iron-rich olivine are present. Chlorite is replacing biotite, which is considered to be primary. In one section, veinlets of cross-fibre chrysotile were observed. Horwood (1945, p. 48) makes the following statement:

> Intrusive masses of pyroxenitic rock have been found on the McKenzie Red Lake property and at the northeast corner of Russett Lake in the east-central part of Baird township. At the latter locality the rock appears to be a basic phase of the hornblende gabbro. It is medium- to coarse-grained in texture and grey black in colour and is composed almost entirely of hypersthene and its alteration products, antigorite and magnetite. Some carbonate has been developed and is the only other constituent.

Butler (1955, p. 80) examined thin sections from some of these rocks collected from Madsen. He makes the following statement: "major constituents are actinolite, epidote, talc and minor amounts of hornblende, magnetite and carbonate are present. One specimen contained large grains of olivine which is partly altered to antigorite." Butler (1955, p. 75) also states that one of the thin sections from a rock specimen at Madsen contained 95 percent hornblende in large euhedral grains, with small amounts of carbonate and magnetite.

From the thin-section evidence it appears that the serpentinites and tremolite-talc schists are altered peridotites. The hornblendite described by Butler is also an ultrabasic rock, but appears to be more closely allied to the metagabbro.

GRANITIC ROCKS

The eastern part of the Killala-Baird batholith underlies much of the western part of Baird township as well as Killala township farther west. The Faulkenham Lake stock extends westward from Faulkenham Lake toward the south end of Flat Lake. The Dome stock lies mainly outside Baird township but may enter the township near the northeast cornerpost. Several granitic dikes are found within the welded tuff unit in the southern part of the map-area, and a few other granitic dikes are found in the northern part of the map-area.

A small crosscutting granitic dike occurs on Madsen claims K.R.L.12524 and 12529 immediately north of the power line, and strikes in a northwest direction. This dike cuts pillow lava and a sill or dike of metagabbro, indicating that it is later than the metagabbro. Acidic dikes also occur in the Madsen and Starratt Nickel mines. These dikes also strike northwest and dip flatly to steeply.

The rocks of the Killala-Baird batholith are generally pink and contain crystals of feldspar, quartz, and biotite up to 3 millimetres in diameter. The outcrops on the west shore of Flat Lake, near the south boundary of claim K.R.L.21316, contain narrow stringers of reddish feldspar, which strike in an east-west direction. Inclusions were observed in the granitic outcrops of claim K.R.L.2585 of the Aiken property.

MINERALOGY OF GRANITIC ROCKS

	1	2	3	4	5	6
	percent	percent	percent	percent	percent	percent
Quartz	31.0	22.9	24.9	1.6	18	24.7
Plagioclase	48.0	59.6 (An_{12})	54.8	61.7 (An_{12})	22 (oligoclase)	41.0
Orthoclase	———	10.6	13.3	31.3	45	3.0
Microcline	19.6	———	———	———	10	———
Perthite	———	———	———	———	———	24.3
Biotite	1.2	4.8	5.9	———	4	5.8
Epidote	0.1	———	0.2	2.9	———	———
Apatite	———	0.2	———	———	———	———
Titanite	0.1	0.7	0.5	0.1	———	———
Magnetite	———	0.1	0.2	———	1	0.9
Leucoxene	———	0.5	———	0.4	———	———
Chlorite	———	0.4	———	2.0	———	———
Total	100.0	100.0	100.0	100.0	100	99.7

1. Granodiorite—Killala-Baird batholith, No. 3 post K.R.L.21276, Aiken Red Lake property.
2. Granodiorite—Killala-Baird batholith, Flat Lake, west shore, claim K.R.L.12875.
3. Granodiorite—Faulkenham Lake stock, K.R.L.12875, New Faulkenham property.
4. Monzonite—Dike, outcrop north of Roger Lake, and 2,500 feet west of southeast corner of Baird township.
5. Granite—Horwood (1945, p. 51) "Normal Granitic Rocks".
6. Granodiorite—Gummer (1941, p. 649) G-92, Dome stock, Fairlie township, small island 9,500 feet north of northeast cornerpost of Baird township and 4,000 feet west of the township line.

The rocks of the Faulkenham Lake stock are very similar to those of the Killala-Baird batholith and contain prominent feldspar, quartz, and biotite. On the shores of Faulkenham Lake these rocks are pink but farther to the west tend to be grey. Many inclusions are present in the rocks west of the Starratt townsite. One small body of diorite forms part of the Faulkenham Lake stock south of the shaft of Starratt Nickel Mines Limited. This rock is darker in colour and contains grey feldspar and hornblende as well as partly assimilated inclusions.

The granitic dikes are a light pink colour and usually contain quartz and feldspar. The content of mafic minerals is lower than that of similar rocks in the larger intrusive bodies.

Thin sections from the Killala-Baird batholith contain feldspar that is fairly fresh, has an index lower than balsam, and has very little twinning. Some of the larger crystals show zoning, and the central parts of these crystals are cloudy masses of alteration. One section showed a considerable amount of microcline, but in the other sections the potassium feldspar is orthoclase and occurs in irregular zones along the borders of albite. Biotite forms well-developed crystals, and quartz forms patches of interlocking grains.

The thin section from the Faulkenham Lake stock also shows feldspar with an index lower than balsam and very little twinning. The orthoclase is partly along the borders of the plagioclase, but some parts extend into the crystals. Biotite is in stringy flakes associated with leucoxene, and these minerals are replacing an earlier ferromagnesian mineral. The thin section from the granitic dike contained fairly fresh plagioclase with little twinning. Orthoclase is the predominant potash feldspar and occurs associated with the plagioclase, but a few grains show microcline twinning. The content of dark minerals is very low.

From the limited thin-section examination it appears that most of these rocks are granodiorite. No rocks having the high proportion of potash feldspar to the total feldspar as given by Horwood have been examined. The one specimen from the dike rocks is a monzonite very close to the monzonite-syenite border. Because of the limited number of thin sections examined it is considered best to call all these rocks granodiorite.

QUARTZ-FELDSPAR PORPHYRY

These rocks occur mainly as dikes less than 25 feet wide. All the dikes mapped are cutting either the basaltic flows or some intrusive rock. If such rocks exist in the welded tuff unit they have not been identified, and in the underground workings there has been confusion between intrusive and extrusive rocks of the same appearance.

A dike of this type is present near the west boundary of the Redruth property, where it has been traced by mapping for 4,500 feet. This dike was intersected by drilling near the central part of K.R.L.20404, but the location of the drillhole is unknown. Other less persistent dikes exist in the northern part of the map-area.

These dikes weather light-buff and in many places contain phenocrysts of quartz and feldspar with diameters up to 3 millimetres, and may contain up to 20 percent biotite with the crystals in parallel orientation. The feldspars of some of these dikes are now altered to sericite, and only quartz phenocrysts remain. No thin-section study of these rocks was made by the author, and thin-section descriptions by other authors are believed to describe quartz-feldspar porphyries that belong to the welded tuff unit.

POST GRANITE BASIC DIKES

Porphyritic Metagabbro

These dikes are known to cut the granite in some places. The porphyritic metagabbro locally called "turkey-track" is of distinctive appearance, and all such dikes are included as part of this group even when they are not in contact with granitic rocks.

Porphyritic metagabbro ("turkey-track"), west shore of Faulkenham Lake on the boundary of claims K.R.L. 11502, and 12638.

One large dike of porphyritic metagabbro with a smaller dike nearby extends northeast from High Lake near the shore of Faulkenham Lake to the east boundary of the township. This dike is exposed for a length of 4,500 feet and for much of this length it is about 200 feet wide. It shows a sharp contact with the Faulkenham Lake granodiorite but does not have a chilled contact, as phenocrysts are present immediately adjacent to the contact. This dike contains

light-coloured tabular feldspars up to 8 millimetres long. These feldspars tend to be arranged in radiating clusters to resemble the imprint of a bird's foot and consequently are called "turkey-track". At certain localities on McKenzie Island in Dome township similar rocks with phenocrysts up to 20 millimetres long have been observed.

MINERALOGY OF THE PORPHYRITIC ("TURKEY TRACK") METAGABBRO

	1	2	3	4
	percent	percent	percent	percent
Quartz	1.3			
Plagioclase	42.0(An_{32})	52.1(An_{45})	51(An_{30})	40(An_{35})
Hornblende	48.6		42	
Actinolite		26.1		
Augite		3.0		
Biotite	6.8	15.4	5	25
Chlorite				25
Epidote		2.3		2
Magnetite	1.3	1.0	3	5
White mica				3
Apatite		0.1		
Total	100.0	100.0	100	100

1. Near shore Faulkenham Lake, K.R.L.11502.
2. Dome township, McKenzie Island, 500 feet west of west boundary of claim K.R.L.11354 of the South McKenzie property.
3. Horwood (1945, p. 49) North shore McKenzie Island, K.R.L.11238.
4. Horwood (1945, p. 48) Lake Rowan mine, Todd township.

In these rocks the phenocrysts form an estimated 15–20 percent of the total. In specimen No. 1 above, the larger plagioclase phenocrysts are fractured in places, and patches of alteration extend across some crystals. The hornblende and feldspar show mutual boundaries, although some small hornblende crystals are included within the feldspar. The andesine feldspar of these rocks places them in the diorites, although the content of dark minerals in excess of 40 percent, as well as the presence of augite, indicates that they have affinities with the gabbros.

Metagabbro

These dikes are similar in appearance to metagabbro elsewhere in the map-area, that is, not associated with granitic rocks. The width of these dikes is usually less than 25 feet, and they are present in small numbers in both the Faulkenham Lake stock and in the Killala-Baird batholith. On the weathered surface these rocks are greenish to black and contain prominent hornblende crystals up to 5 millimetres in diameter and small tabular feldspars.

	1	2	3
	percent	percent	percent
Quartz		0.2	14.50
Plagioclase	37.2	40.1	49.07(An_{30})
Hornblende	56.1	46.2	
Augite		2.5	
Biotite	3.4	3.4	3.38
Chlorite	0.1	0.2	10.06
Dolomite			8.94
Apatite			0.77
Magnetite			4.05
Ilmenite		0.2	1.87
Leucoxene		1.7	
Pyrite			0.51
Epidote	0.2	5.0	
Carbonate	0.7	0.5	
Tourmaline	0.8		
Unassigned H_2O			0.15
Total	100.0	100.0	100.39

1. New Faulkenham property K.R.L.12875.
2. Dome township, Howey Consolidated K.R.L.741.
3. Horwood (1945, p. 55) No. 3 recast.

Thin-section No. 1 in accompanying table contains feldspar with an index higher than balsam and has Carlsbad twinning but little albite twinning. Hornblende is well developed, and at the contact with adjacent feldspar grains, the hornblende has protuberances that extend into the feldspar. Much of the feldspar is included within the hornblende. From the index of the feldspar and the above comparison with an analyzed specimen the feldspar is presumed to be oligoclase. Because of the presence of augite and the high content of mafic minerals this rock is considered to be metagabbro.

Cenozoic

Pleistocene

The thickness of the glacial deposits is variable but generally is fairly thin particularly in the part of the map-area to the southeast of Russet Lake and Flat Lake. Twelve glacial striae were recorded in the map-area. Five of these are at S.55°W., and the balance averages S.40°W., with a range from S.35°W. to S.50°W. On the outcrop east of the bay at the outlet of Flat Lake, on the boundary between K.R.L.12601 and 12964, two sets of striae are present at S.40°W. and S.55°W. The set of striae at S.55°W. appears to be of later age. Throughout the northern part of the township the direction of glacial movement is at a large angle to the strike of the rocks, and many outcrops have their longer diameter across the strike. Small boulder ridges have their long axes parallel to the ice front, indicating that they are small terminal moraines deposited by ice movement.

The only glacial sections that have been observed within the township are on the shore of St. Paul Bay on either side of the creek draining Russet Lake. The section east of the creek is about 100 feet long and about 20 feet high and consists of fine sand with horizontal bedding. The section west of the creek is about 250 feet long and 20 feet high. The upper 5 feet of this section

consists of fine sand, and the lower part of this section is covered by slumped material, but some fine gravel is present. The bedding is flat throughout most of the section, but at the west end dips west.

Gravel pits have been worked on Madsen claim K.R.L.11505, and on claims K.R.L.12875 and 12876 of the New Faulkenham property. A gravel ridge is present on the township's east boundary on the north side of the small lake near the southeast cornerpost.

Outcrop showing two sets of glacial striae, Madsen claim K.R.L.12601.

Recent

A sandy beach is present along the south side of St. Paul Bay on claim K.R.L.17960, where wave action has moved the sand along shore from the glacial sections farther west. Recent deposits consist mainly of organic material deposited in the swamps and tailings from the mines. The tailings from the mines are largely impounded behind dams across the valleys into which the tailings are discharged. Streams from these tailings-ponds are building deltas beyond the dams.

MAGNETIC SURVEYS

Ontario Department of Mines-Geological Survey of Canada aeromagnetic maps 851G, Gullrock Lake, and 852G, Red Lake, and Ontario Department of Mines aeromagnetic map, West Red Lake, at a scale of one inch to one mile, cover the area. On these sheets the magnetic data were obtained on lines at a

mean flight spacing of 2,640 feet, and a mean terrain clearance of 500 feet. An aeromagnetic map of the area was supplied to the author by Mespi Mines. This map is at a scale of ½ mile to the inch, and the mean flight-line spacing was 660 feet, and the mean terrain clearance 200 feet.

One ground magnetic survey for a property previously held by Riverdale Gold Mines Limited is included with the assessment work reports for Baird township. This property was immediately north of the south boundary of the township in the vicinity of Milepost 2. A magnetic survey for a part of the Madsen Red Lake Gold Mines property was supplied by the company. Additional magnetic traverses were made by members of the field party. These traverses were mainly restricted to areas where outcrop information is poor and aeromagnetic maps indicated zones of strong magnetic intensity.

During the survey a one-man, vertical-intensity type, Sharpe magnetometer was used with a scale constant of 20 gammas per scale division. The magnetic base level is the base level used by Mining Geophysics Corporation Limited for surveys in Balmer township and for the following Ontario Department of Mines maps: Bateman township, southern part, map No. 2016; Balmer township, map P. 47 (revised 1961); McDonough township, part of south half, map P.124; and Dome township, map P. 125. Part of the survey on the Madsen property was incorporated with this survey by rereading a group of stations in order to adjust the station data to the new base level.

The ground magnetic relief in areas underlain by altered ultrabasic rocks generally ranges from 1,000 to 4,000 gammas above the base level, and in one anomaly a maximum of 8,000 gammas was recorded. Detailed magnetic observations in the vicinity of the altered ultrabasic dike, within and adjacent to the Austin tuff, show that the dike is marked by a series of local anomalies of 1,000 gammas, rather than by a continuous anomaly.

STRUCTURAL GEOLOGY

Structural information on the basaltic rocks has been obtained from the observation of strikes and dips of pillow lava and flow-top breccia as well as from the interflow iron formations. The shape of pillows has been used to determine the facings of flows. One plunge determination was made on claim K.R.L. 20403 of the Redruth property by using the shape of pillows. A few structural observations were made on the rocks of the welded tuff unit where bands of breccia exist and where the basic lavas are interbedded with acidic rock types. Surface information has been supplemented by drilling and underground information supplied by mining companies. From information obtained in Baird township, as well as from adjacent townships, it is believed that the rocks of the welded tuff unit overlie the rocks of the older basic lava group.

Folding

In the northern part of the map-area the zones of pillow lava and flow-top breccia have been used as marker beds. Two of these prominent, adjacent marker beds, 200–400 feet thick, persist throughout much of the area. Using these marker beds and information on strikes and facings, a pattern of anticlines and synclines has been worked out that trends and plunges in a northwest direction.

Baird Township

The observed dip of the marker beds adjacent to the Killala-Baird batholith is away from the batholith at angles ranging from 50 to 65 degrees, and in this vicinity the limb of the anticline is strongly overturned. The single iron formation exposure on K.R.L.1612 of the Aiken property is flat-lying, and the two exposures of iron formation on K.R.L.18486 of the Redruth property do not agree closely with the structural trends of the lavas. Elsewhere the strikes and dips of the bands of iron formation supplement and correspond with the strikes and dips obtained from the lavas. In the northeastern part of the township the three bands of welded tuff are considered to be synclinal areas and the adjacent basalts to be anticlinal areas with the structures plunging to the southeast.

The trend of the tuff beds in the basal part of the welded tuff unit is N.55°E. on the Starratt Nickel property, then N.40°E. for 9,000 feet on the Madsen property, and then changing to N.50°E. near the east boundary of the township. The beds near the contact dip from 70° to 85°SE. on the Starratt Nickel property and from 65° to 70°SE. near the Madsen No. 2 shaft. The zones of fine-grained rocks within the welded tuff unit south of the Faulkenham Lake stock trend N.70°E., but farther to the west the strike is arcuate and curves to slightly north of west. In this area the few dips recorded are from vertical to 80°S.

No determinations of the tops of beds have been made in the welded tuff unit except where a pillow lava is associated with the tuff. The top determinations by the shape of pillows indicate facings to the southeast only, but the distribution of outcrops of pillow lava and uniform lava suggests that these rocks may be part of a syncline. Mapping in Heyson township confirms this hypothesis, and the anticlinal and synclinal axes located in Heyson have been projected into Baird township.

In spite of the large angle between the strike of the major structures in the basalts and in that part of the welded tuff unit adjacent to the Starratt and Madsen properties, no sharp discordance is present at the contact. The strike of the older lavas swings into conformity with the strike of the welded tuff near the contact, and the lower tuff beds are believed to be interbedded with the lavas.

Faulting

Only one fault was observed in surface mapping by members of the field party. This fault is on the New Mallen Red Lake property and strikes N.70°W. The apparent horizontal displacement is about 200 feet, the north side is relatively displaced toward the west. Surface mapping by company geologists on the Redaurum Red Lake Gold Mines property indicates that part of the south band of iron formation on claim K.1537 is displaced about 50 feet northward. The strike of this fault is uncertain but probably is northeast.

No major faults have been recognized in the underground workings of the Madsen mine. The level plans of the Starratt Nickel mine show several crossfaults that strike from N.25°E. to N.40°E. and have apparent horizontal displacements up to 200 feet.

Shearing

No strong shear zones have been observed. The few recorded observations of schistosity are believed to represent axial plane cleavage and would be parallel to the axial planes of folds and not related to later shearing stresses.

ECONOMIC GEOLOGY

Gold

In 1927 the Madsen No. 1 vein was staked (Hurst 1936, p. 35), which is the first known mineral discovery in the township. All production to date has come from two adjacent properties, one of which is currently in production. At two other locations underground workings exist.

The host rocks for the gold ore are tuffs at or near the base of a thick unit of welded tuff. At another locality the shaft was sunk in carbonatized basalt, and at the other location the host rock is welded tuff adjacent to a granitic dike. The gold-bearing structures are veins and silicified and mineralized tuff zones.

Sulphides

Small amounts of sulphides are associated with the quartz veins and in the tuff beds on the properties of Starratt Nickel Mines Limited and Madsen Red Lake Gold Mines Limited. An outcrop at the south end of Flat Lake and an outcrop on the shore of St. Paul Bay contain considerable amounts of iron sulphides. Within the tuff beds at the Madsen and Starratt Nickel mines the predominant sulphides are pyrite and pyrrhotite with small amounts of sphalerite, arsenopyrite, and chalcopyrite.

Scheelite

Occurrences of scheelite have been recorded from several locations in the township, but no deposits approaching economic grade are known.

Gravel

No extensive gravel deposits are known in the area mapped. A small, shallow pit occurs on Madsen claim K.R.L.11505, and the gravel obtained was probably used as road material. A pit on the New Faulkenham property is at the south end of the small lake on claims K.R.L.12875 and 12876. A ridge of sand and gravel was observed on the east boundary of the township immediately north of the small lake near the southeast cornerpost. Beds of fine sand are exposed in the shore cliff of St. Paul Bay on each side of the creek mouth.

Recommendations for Exploration

The obvious recommendation is that the tuff beds at the Madsen and Starratt Nickel mines should be investigated along the strike from the productive zones. To the northeast these beds extend into Heyson township, and to the southwest they would be expected to occur at the south end of Flat Lake. As the tuff bed at Madsen mine that contains the major orebodies is located at the contact between the metabasalt and welded tuff unit, this contact should be investigated wherever it occurs. At the Howey and Hasaga mines, and more recently at the Wilmar mine, orebodies have been found within the welded tuff unit, and the mineralization of No. 2 zone at the Parvus property is within these rocks. At the McKenzie Red Lake gold mine, a vein containing gold was located at the contact between a granitic stock and the adjacent welded tuff unit. Two mines of the Red Lake area have produced gold from veins contained within granitic rocks, and the orebodies of three of the largest producers are within the metabasalts; for one mine, production was obtained from veins within a

carbonate body which was contained within the metabasalts. This association of gold deposits with many types of host rock means that, except for dikes that are later than the gold mineralization, no rock types should be excluded from prospecting on the basis that they are unfavourable to gold deposition.

Heavy sulphide mineralization was observed at two places. At a point on the south side of St. Paul Bay, rusty staining is present on the rocks, and trenching has exposed a heavy impregnation of pyrrhotite in welded tuff. Abundant pyrite and pyrrhotite in rocks of the welded tuff unit are exposed in a pit on the outcrop at the south end of Flat Lake. Iron formation containing abundant pyrite has been reported to the author (C. D. Huston, personal communication) as occurring at the south end of the small lake on claim K.R.L. 19720 of the Aiken Red Lake property. Elsewhere, most iron formations shown on the map have been trenched by prospectors and contain small amounts of sulphides.

Basic and ultrabasic rocks are present in many places. No copper mineralization was observed in these rocks, but thread veinlets of asbestos in altered ultrabasic rocks have been observed in adjacent townships.

Description of Properties

Aiken Red Lake Gold Mines Limited

Five claims of this group were formerly held by Flat Lake Gold Mines Limited, which was incorporated in 1938 to take over the group from Ross Red Lake Syndicate. Aiken Red Lake Gold Mines Limited was incorporated in 1945 to take over a group of twenty-six unpatented claims, which in addition to the claims of Flat Lake Gold Mines included the Roberts, Aiken, Humlin, and Spiers claim groups. The property in 1962 consisted of thirty-seven patented claims.

Exploration of the property by the present company was in progress during 1945 and 1946, when 5,000 feet of trenching and 5,000 feet of drilling were done. Most of the drilling on No. 1 vein was on cross-section lines. No. 1 vein zone was trenched for a length of 2,000 feet, and the zone showed widths from 6 to 26 feet. This vein was tested by 20 drillholes with a combined length of 3,320 feet, for a length along the strike of 1,200 feet. Hole No. 39 gave an assay of 0.15 ounces of gold per ton over a length of 5 feet, and holes Nos. 43, 46, and 58 gave a section 110 feet long by 3.8 feet wide, which averaged 0.14 ounces of gold per ton. (Northern Miner 1945b, p. 821; 1946c, p. 287).

The following excerpt is from the Northern Miner (1946d, p. 533).

> Several veins were located. The most important were Nos. 1 and 2. The first was located where formation was cut by a large diorite dike. Values were obtained in vein matter introduced into the fractured and heavily mineralized iron formation. No. 2 vein is a narrow vein of bluish quartz carrying considerable gold at a point near a granodiorite porphyry dike.

Childs Red Lake Gold Mines Limited

Childs Red Lake Gold Mines Limited held a group of nine claims in the southern part of Baird township and in the area south of the township line. This property was adjacent to New Faulkenham Mines, Starratt Nickel Mines, and New Mallen Red Lake Mines. The company charter was cancelled in 1959.

On claim K.R.L.28231 a total of 919 feet was drilled in nine holes. Holes Nos. 4–9 were drilled north or south from a base line extending northwest from No. 2 post. Holes Nos. 11 and 12 were in the northeastern part of the claim.

Humlin Red Lake Mines Limited

The company was incorporated in 1945 to take over a group of claims from John Humlin. The present property consists of seventeen patented claims and licenses of occupation located mainly in Fairlie township, with parts of some claims extending into Baird township.

Howey Gold Mines opened up a series of rock trenches on the shore in claim K.R.L.18413, and in 1941 drilled in that vicinity. John Humlin located a vein in the southern part of the property, probably on claim K.R.L.18424. This vein was striking northeast, and drilling was done by the company in this vicinity and also near the other showing on claim K.R.L. 18413.

A description of activities at the property is as follows (Northern Miner 1945a, p. 797):

> Present work is concerned with exploring a strong shear which strikes along the shore and out under the water. Two drills have been operating. Holes at the northwest end are at 30 foot intervals to cut the structure at 100 feet, other holes are 40 feet apart. The surface showing was opened by a series of heavy rock trenches when the discovery was investigated by Howey several years ago. This work is understood to have indicated a short shoot 150 feet in length, 12 feet wide with an approximate grade of $4.50 [0.13 ounces of gold per ton].
>
> High values were obtained in the discovery trench in the new find near the company's southern boundary. Here a heavily sheared and schisted zone intruded by a small quartz vein is exposed. Arsenopyrite mineralization and visible gold have been seen with a chip sample giving values of $59.80 [1.71 ounces of gold per ton] across three feet and an additional three feet on the footwall returning $4.30 [0.12 ounces of gold per ton].

Drillhole No. 39 beneath the shear zone on the shore gave an intersection 1.8 feet in length that assayed 4.88 ounces of gold per ton at a depth of 485 feet. A slightly deeper section in the same hole gave an assay of 0.32 ounces of gold per ton for a core length of 2.5 feet (Northern Miner 1946a, p. 96).

Madsen Red Lake Gold Mines Limited[1]

HISTORY AND DEVELOPMENT

The company was incorporated in 1935 and has been in continuous production since 1938. The mine is located 7½ miles by road, southwest of the settlement of Red Lake, and has its own townsite.

The area in which No. 1 shaft is located was first staked in 1928 (McLaren 1947, p. 791), and along with adjacent claims, which were staked by Marius Madsen, became the property of Falcon Gold Syndicate in 1934. The present company acquired twenty-nine claims from Falcon Gold Syndicate and the adjoining group held by Jomac Gold Syndicate. In 1941 an additional group of fifteen claims was obtained from Rouge D'Or Mines Limited, and the property of Redwood Gold Mines Limited consisting of twelve claims was added in 1950. The company staked eight claims at the north end of Russet Lake in 1954, and this claim group is now ready for patent. Twelve unpatented claims, south of the main group, are located in Heyson township.

Development work began in 1936, and No. 1 shaft was sunk to a depth of 575 feet with levels at 100, 212, 325, 437, and 550 feet below the collar. Underground work on the levels consisted of 675 feet of crosscutting and 2,381 feet of drifting. Horwood (1945, p. 180) states that some excellent assays were obtained, but no ore shoots were outlined.

[1]Property description was written in conjunction with F. G. Harriman, Chief Geologist, Madsen Red Lake Gold Mines Limited.

Austin McVeigh, a prospector employed by the company, discovered a mineralized shear zone near the northeast corner of Beaverdam Lake on claim K.R.L.12523 in July 1936. Diamond-drilling in this vicinity indicated the presence of a large body of low-grade ore, and exploration activities were transferred to this location.

During 1937, No. 2 shaft was sunk to a depth of 535 feet, and levels established at 200, 350, and 500 feet below the collar. Since that time, the shaft has been deepened to 4,175 feet with 25 levels established. The total development work to the end of 1962 consisted of 142,542 feet of drifting, 25,432 feet of crosscutting, 57,857 feet of raising, and 1,414,374 feet of diamond-drilling. Milling was commenced in 1938 at a rate of 300 tons per day, which was increased to 400 tons per day in 1939, and to 800 tons per day in 1948.

GENERAL GEOLOGY

The country rocks are of early Precambrian age. An older group of basic lavas is overlain by a welded tuff unit consisting of tuffs and a thick section of porphyritic latite, with minor latite breccia and some interbedded basic lavas. These rocks are intruded by an altered ultrabasic dike and plutons of metagabbro and by minor dikes.

BASALT

The basalt in the mine is generally fine-grained and structureless, but in a few places on surface, pillows may be seen, and some flow-top material occurs in the basalt adjacent to its contact with the tuff. Near zones of shearing, the basalt becomes brown in colour due to the development of biotite. Some recrystallization of the lavas has occurred adjacent to the larger masses of diorite. The mineral constituents of the basalt are mainly plagioclase and tremolite or hornblende, with smaller amounts of quartz, biotite, chlorite, carbonate, and magnetite.

TUFF AND WELDED TUFF UNIT

At the Madsen property the welded tuff unit consists of two main parts. The basal part of the unit consists of tuff beds interbanded with some basaltic lava and some intrusive rocks. The upper part of the welded tuff unit consists mainly of porphyritic (quartz, feldspar) latite.

The tuffs are persistent stratigraphic units, which range in width from a few feet to over 600 feet but average about 200 feet. They are important economically since all the orebodies are contained in them. Banding is faint but in places approaches that of sedimentary rocks; these rocks presumably are either composed of tuffaceous material or are of normal detrital origin. The two main tuff bands are the McVeigh tuff and the Austin tuff. The Austin tuff is much more important economically and is divided into two parts by a dike of altered peridotite. These parts of the tuff are called the South Austin tuff and the Main Austin tuff.

The Austin tuff is a fine-grained brownish to greenish rock, with rather fine banding in some localities. Individual bands within the tuff are generally less than an inch in width. Parts of the tuff contain angular fragments up to ½ inch in size, and one bed was observed to consist of equal amounts of fragments and matrix. Some brecciated chert lenses have been found near the lower contact, and the hanging wall in places consists of siliceous volcanic breccia with a

tuffaceous matrix. Most fragments in the breccia are less than 4 inches in diameter, but a few have a length of several feet. Many of the fragments are fine-grained rocks, but a few are quartz-feldspar porphyry similar to the rocks in the main part of the welded tuff unit. The mineral constituents of the tuff vary from place to place and across the band. An approximate composition given by Butler (1955, pp. 39–43) is: plagioclase, 45 percent; quartz, 15 percent; with smaller amounts of amphibole (either hornblende or tremolite-actinolite), biotite, sericite, epidote, garnet, andalusite, carbonate, magnetite, tourmaline, pyrite, and pyrrhotite. Garnets are a common constituent and tend to be numerous near the ore but are seldom present in the ore. One tuff bed contains up to 90 percent garnets and was used as a local marker bed. Rose (1955, p. 5) has observed that staurolite and andalusite are frequently developed, especially near the hanging wall.

The McVeigh tuff is generally of similar appearance to the Austin tuff. Butler (1955, p. 55) states that the four thin sections of this tuff that were studied consisted almost entirely of amphibole and biotite.

"SHEARED FELDSPAR PORPHYRY"

Lenses and pods of these rocks are associated with the tuffs, and the present discontinuous parts may have once been continuous, but have been separated by the flowage of more plastic rocks. Microscopically, these rocks consist of recrystallized quartz with asscciated muscovite, chlorite, and feldspar. They are conformable with the tuffs, and the authors consider them to be of similar origin to the porphyritic latite. Former mine geologists were about equally divided as to whether these rocks are intrusive or altered sedimentary rocks. Intrusive porphyries may be present in the mine, but if so they have not been differentiated from the extrusive porphyries.

PERIDOTITE

An altered peridotite, called locally the South Austin "footwall talc", is generally about 50 feet wide, but ranges from 30 to 200 feet. It cuts across the Austin tuff and divides the tuff in the South Austin and Main Austin sections. Farther northeast the same band of talc is at the base of the Austin tuff and then progresses stratigraphically lower across a basalt flow to the base of that flow. Microscopic work has indicated that this dike is altered peridotite.

"HORNBLENDE DIORITE"

A sill of "hornblende diorite" over 250 feet thick overlies the McVeigh tuff at No. 2 shaft. The sill is mainly concordant with the enclosing rocks except for some bulges in the hanging wall that cuts out the ore in parts of the South Austin zone Parts of this body, particularly a narrow zone on the footwall, are altered to talc schist.

LATE DIKES

Numerous swarms of dikes are present within the mine area and range in composition from diorite to granodiorite. Individual dikes range in width from a few inches to 60 feet. The general strike of these dikes is N.60°W. and the dip is 30°NE. The larger and more persistent swarms are shown on the longitudinal projection. Mine geologists agree that these dikes are post-ore in age.

STRUCTURE

The general strike of the country rocks is N.30°E. at No. 2 shaft, and at 2,500 feet northeast the strike changes to N.45°E. The dip at No. 2 shaft is 65°SE. The rocks of the welded tuff unit are considered to be younger than the basalts. Because of this relationship the tuff beds, that contain the ore, are considered to be along the limb of a fold with a synclinal area within the rocks of the welded tuff unit and an anticlinal area within the adjacent basaltic rocks.

The trace of the hanging wall of the tuff beds is irregular, being repeatedly flexed outward (to the southeast) and then swinging back inward (to the northwest). The size of the flexures varies with smaller flexures superimposed on the larger. These flexures all have a common axial direction, which is slightly south of east, and the plunge is 45–60 degrees. The hanging wall and footwall flex in opposite directions in any particular locality, so that the enclosed tuff band forms lens-like bodies separated by narrow waists or constrictions.

OREBODIES

As viewed in longitudinal projection the orebodies from southwest to northeast are: the South Austin zone, McVeigh zone, Main Austin zone, Austin No. 4 zone, Austin East zone, and Austin No. 3 zone. All the known ore occurrences lie within the tuff beds, and all orebodies are lenticular zones that are silicified, carbonatized, and mineralized.

Rose (1955, p. 10) gives the following description:

> The ore lenses are more highly sheared than the brown tuffs, and usually more silicified. The gold content varies directly with the degree of silicification. Pyrite with lesser amounts of pyrrhotite comprise the bulk of the ore minerals. Arsenopyrite, magnetite, ilmenite and titanite are common; chalcopyrite, sphalerite and scheelite are less common. Molybdenite, realgar and orpiment are rare. Minor amounts of lead, manganese, nickel, vanadium, cobalt and chromium are indicated by spectrographic analyses.
>
> Most of the gold is fairly coarse and is found plating the mineral grains. Some of the gold is very fine and is contained in the mineral grains. It is not economically possible to extract the fine gold. Visible gold is common in the more siliceous parts of the ore. Narrow stringers of green carbonate occur erratically and usually carry much gold.

ANALYSES OF THE ORE

Mineral[1]	Weight Percent	Constituent[2]	Weight Percent	Ounces Per Ton
Quartz	35	SiO_2	51.66	—
Biotite	39	Al_2O_3	12.29	—
Pyroxene	10	CaO	6.10	—
Chlorite	5	MgO	3.62	—
Calcite	5	Fe	9.20	—
Epidote and garnet	5	S	3.51	—
Pyrrhotite, pyrite, arsenopyrite, ilmenite, magnetite, chalcopyrite	1	As	0.04	—
		Cu	0.02	—
		Au	—	0.2359
		Ag	—	0.05
Total	100	Total	86.44	—

(1) Mathieu (1962, p. 3). Heavy liquids were used for mineral separation, and identification was by microscopic and x-ray methods. The sample was taken from millheads.
(2) Van Loon (1951, p. 105). A composite sample from the Madsen mill-feed for the month of June, 1940.

Twenty-four polished sections and six thin sections were examined by Hughson and Kaiman (1962, pp. 1–4) from ore specimens collected from stopes

below the 2,650-foot level. All mineral identifications were confirmed by x-ray diffraction methods. The following excerpts are taken from the report:

> The most abundant constituents are quartz and sericite. In addition to calcite the minor minerals include sphene, amphibole, garnet, magnetite, sulphides and native gold . . .
>
> Pyrite and pyrrhotite are much more abundant than arsenopyrite and chalcopyrite. The sulphides occur as disseminated grains either randomly distributed or segregated into bands of varying density. Only pyrrhotite was observed in massive seams . . .
>
> Fine-grained anhedral magnetite is locally abundant, commonly in the vicinity of pyrrhotite or arsenopyrite. Magnetite may also form minute veinlets and may rim sulphide minerals or be intergrown with them . . .
>
> Gold occurs as the native element, usually in minute particles in non-opaque minerals. In a few places particles of native gold are surrounded by or attached to grains of other metallic minerals, including pyrite, pyrrhotite, chalcopyrite and magnetite. No visible gold is associated with the arsenopyrite. Most of the gold particles average about 4 to 5 microns in size.

Gold recovery in the mill has averaged 94.00 percent during the time that the mill has been in operation. During 1962 the milling operation recovered 92.7 percent of the gold contained in the ore.

Bishop (1952, p. 1) gives a table of the tonnage and grade distribution from surface to the 11th level. The tonnages given represent the ore in place before dilution. The small tonnages of the South Austin and McVeigh zones are not included in the estimate.

TONNAGE AND GRADE DISTRIBUTION

Level[1]	Interval	Tonnage	Gold Per Ton	Per Vertical Foot	Per Vertical Foot
	feet		ounces	tons	ounces
1st	200	170,000	0.195	1133	221
2nd	150	205,750	0.170	1372	233
3rd	150	125,000	0.186	833	155
4th	150	106,360	0.212	709	150
5th	150	156,300	0.223	1042	232
6th	150	306,920	0.215	2046	440
7th	150	286,530	0.270	1910	516
8th	150	204,240	0.242	1362	330
9th	150	221,490	0.224	1477	331
10th	150	246,000	0.240	1640	394
11th	150	222,000	0.218	1480	323
Total	1700	2,250,600	0.222	1364	303

[1] Because of the surface pillar, effective mining height is taken as 150 feet.

Madsen Red Lake Gold Mines Limited, Annual Report 1962, for the annual meeting 24 April 1963, gives the following statement of ore reserves, 31 December 1962:

SUMMARY OF ORE RESERVES

	Reserves	Gold Per Ton	Gold in Reserves
	tons	ounces	ounces
Surface to 1,100-foot (7th) level	14,430	0.343	4,943
1,100–1,700-foot (11th) level	36,903	0.344	12,704
1,700–2,650-foot (17th) level	250,349	0.306	76,560
2,650–3,500-foot (22nd) level	481,545	0.345	166,237
Broken reserve	62,173	0.299	18,590
Average grade	———	0.330	———
Total Reserves	845,400	———	279,034

STRUCTURE OF THE OREBODIES

The orebodies occur within the wider portions of the tuff, and the waists or constrictions are unfavourable for ore deposition. Most of the orebodies strike in a more easterly direction than the walls of the tuff band so that they cross the band at a small angle, and they dip more steeply than the walls of the tuff band. Thus the top and northeast end of each orebody is at the hanging wall, and the bottom and southwest end is against the footwall. The one exception is the Austin No. 4 orebody, which is on the footwall throughout the known length. The internal structure of the Austin tuff is poorly known since banding is generally indistinct. The orebodies cannot be seen to truncate bedding and they appear to be conformable. The ore may follow dragfolds within the tuff that are not expressed in the walls of the tuff bed.

Most orebodies consist of numerous lenses which extend down the dip. Individual lenses do not rake, but the zone in which they occur rakes at about 45°NE. Two orebodies do not show this arrangement. The South Austin orebodies rake in conformity with the rake of the ore zones, and the Austin No. 3 zone is vertical from the 1,900-foot level to the present limit of exploration on the 3,500-foot level.

New Faulkenham Mines Limited[1]

Faulkenham Lake Gold Mines Limited was incorporated in 1936 and took over a property of eighteen claims in the southern part of Baird township, adjoining the Madsen Red Lake and Starratt Nickel Mines properties. New Faulkenham Mines Limited succeeded the earlier company in 1948.

DEVELOPMENT

A vein was discovered on claim K.R.L.12881 in June 1936, and surface exploration was concentrated in this vicinity. Twenty holes were drilled with a total length of 2,935 feet. A mining plant was erected, and in January 1937 shaft-sinking began and continued to a depth of 344 feet. Lateral work from the shaft was mainly on the 125- and 325-foot levels, and in October 1937, operations were suspended.

UNDERGROUND DEVELOPMENT

(O.D.M. 1938, pt. 1, p. 123)

Level	Drifts	Crosscuts	Number of Drillholes	Lenth
	feet	feet		feet
125-foot	620	274	———	———
225-foot	———	42	———	———
325-foot	509	138	———	———
All levels	———	———	31	1,445
Total	1,129	454	31	1,445

Between 26 July and 30 September 1958, a total of 4,673 feet of surface drilling was done (Holbrook 1959, p. 2). Eight holes with a total length of 2,919 feet were drilled in the shaft area, and three holes were drilled in the northern part of K.R.L.12881 and on claim K.R.L.12882.

[1]In 1963 the New Faulkenham Mines property was amalgamated with Starratt Nickel Mines.

DESCRIPTION OF DEPOSIT

The quartz vein exposed on surface near the shaft is in the country rocks adjacent to the contact of a granitic dike. Most of the material on the dump is a dark-grey, feldspathic latite cut by stringers of fresh, pink, biotite granite. Quartz stringers from ¼ to ½ inch wide cut both the granite and latite. The quartz is light-grey or smoky and contains narrow seams of disseminated pyrite.

Horwood (1945, pp. 105, 106) gives the following description:

> The fracture zone that contains the quartz lenses has been traced for about 890 feet on surface and for about 450 feet on the two levels underground. It has an average strike of S.73°E. and a dip of about 85°N. It is not persistent or continuous along the strike but tends to pinch and reappear some distance away . . . The quartz lenses that appear in this zone have a maximum width of 29 inches but are commonly under 12 inches. The longest one, on the 125-foot level has been traced for 75 feet. Generally a few small stringers and blebs of quartz occur in the fractures paralleling the main lens.
>
> The quartz lenses are made up of grey to white glassy quartz, which has been slightly fractured and mineralized with pyrite. Small amounts of chalcopyrite, sphalerite and galena have been reported from underground workings. Values in gold are reported to be better where these sulphides occur.

UNDERGROUND VEINS AND MINERALIZATION

(Data from Horwood 1945, p. 106)

Level	Quartz Lens		Mineralization		Gold Content Per Ton
	No.	Length	Length	Width	
		feet	feet	feet	ounces
125-foot	1	50	41	1.4	0.362
	2	75	58	8.8	0.338
	3	75	——	——	Low values
325-foot	——	——	——	——	Little mineralization

In the report of the drilling in the shaft area, in 1958 (Holbrook 1959, p. 2), it is stated that "several intersections of vein material were obtained, but none showed any appreciable values in gold." The drilling on the rest of the property did not intersect any "veins or structures of economic significance."

New Mallen Red Lake Mines Limited

The company was incorporated as Mallen Red Lake Gold Mines Limited in 1944, and in 1960 the name was changed to New Mallen Red Lake Mines Limited. In 1944 the company purchased fifteen unpatented claims from Mulcave Mining and Development Company Limited. These claims adjoin Starratt Nickel Mines Limited on the southwest and have now been patented. The following excerpt is from a company report (Phalen 1961, p. 1):

> In 1946 a geological survey was completed and 3,000 feet of drilling was done. Some low gold values of less than commercial grade were intersected, but the Starratt Olsen tuff was not found.

Parvus Mines Limited

HISTORY

In 1940 the Durham group consisted of seven surveyed claims and three unsurveyed claims in the northeast corner of Baird township. Durham Red Lake Gold Mines Limited was incorporated in 1945 to take over the property of thirteen unpatented claims in Baird and Heyson townships. The company name was changed to Durham Explorations Limited in 1954, and to Consolidated Durham Mines and Resources Limited in 1959. An agreement was made by

which Dickenson Mines Limited was to take control of the property of fourteen patented claims in Baird and Heyson townships. Dickenson was to contribute a ten-claim group to the company and to finance a drilling program on the property. Parvus Mines Limited was incorporated in 1960 to take over the combined group of twenty-four claims in Heyson, Baird, and Fairlie townships. The property now consists of: claims K.1491; K.1502; K.1521–23; K.1572, 73; K.R.L.17960–62; K.R.L.23838, 39; K.R.L.44992–99; and K.R.L.47852, 53; K.1575.

DEVELOPMENT

Early work was by trenching on claim K.1575. During the summer and fall of 1946, a program of prospecting and general exploration was undertaken, during which four gold-bearing veins were discovered and tested by means of trenching and 2,000 feet of shallow diamond-drilling. By July 1947 an additional 13,749 feet of drilling had been done to explore further the Nos. 2 and 4 zones. Seven additional claims were surveyed and patented by Durham Red Lake Gold Mines. Parvus Mines Limited carried out a drilling program in 1962, and in January 1963 the ten unpatented claims in the northwestern part of the group were surveyed.

ORE ZONES

The early work on the property is described by Horwood (1945, pp. 102, 103):

> Several small quartz veins have been found in the dacite. The largest, which has a maximum width of 12 inches has been traced in four trenches for a length of 120 feet, in the south central part of claim No. 16,943 [K. 1575]. Two channel samples across 12-inch widths assayed 1.13 ounces and 0.41 ounces of gold per ton.[1] Pyrite, arsenopyrite, chalcopyrite, and sphalerite have been reported as common sulphides in the vein.

No. 2 zone extends across the southern part of claim K.1573 and into the adjacent claims. It consists of two sections of better grade. The western section has a length of 800 feet in K.1573 and 300 feet in K.1575. The eastern section has a total length of 600 feet, with 500 feet in K.1572 and the balance in K.1573. Early drilling in this zone gave intersections of 2 feet containing 0.36 ounces of gold per ton, and 3 feet containing 1.20 ounces of gold per ton over a core length of 15.5 feet with a central, barren section of 10.5 feet. (Durham Red Lake Gold Mines Limited, Report to Shareholders, 25 March 1947). Further drilling in this zone at 100-foot intervals indicated the persistence of ore-grade gold values, and also that more than one mineralized section exists in many drillholes.

No. 4 zone is in the northeastern part of K.1523. Holes 401, 402, and 403 were drilled at 100-foot spacing and gave intersections of about 0.11 ounces of gold per ton for core lengths of 2.5, 2.5, and 10.0 feet respectively. (Durham Red Lake Gold Mines Limited, Report to Shareholders, 25 March 1947.)

The Financial Post Survey of Mines 1951 (p. 195) gives the following information:

> In No. 2 zone, ore shoot shows a minimum length of 150 feet averaging 0.2523 ounces over 5 feet true width [gold per ton]; 500 feet ore established in No. 4 zone.

Redaurum Red Lake Gold Mines Limited

Paulore Gold Mines Limited was incorporated in 1934 and held a group of eleven claims. Rajah Red Lake Gold Mines Limited was incorporated in 1936 and held a large group of claims in Baird and Heyson townships, which had

[1] W. C. Durham, personal communication.

originally been staked for Dome Mines Limited in 1926 and were restaked in 1933. Redaurum Red Lake Gold Mines Limited was incorporated in 1945 and obtained title to five claims of the Paulore property and the adjacent nine claims of the Rajah property that were entirely within Baird township.

DEVELOPMENT

Paulore Gold Mines Limited explored the property by trenching, drilling, and by underground workings on claim K.1541. Howey Gold Mines Limited drilled the first two holes on No. 2 showing. Rajah Red Lake Gold Mines Limited trenched and drilled one showing on K.R.L.13080. Further drilling has been done by the present company.

SUMMARY OF SURFACE DRILLING

Year	Location	Standard Drill Core		X-ray Drill Core		Total
		Hole Nos.	Length	Hole Nos.	Length	
			feet		feet	
1936	Shaft zone, K.1541	(17 holes)	3,900	———	———	3,900
1939	No. 2 zone, K.1537	H-1, H-2	883	———	———	883
1944–45	Camp zone, K.1540	R16–R20, 35–40	4,789	R22–R31	784	5,573
1945	———	2, 3, 7	840	R-X-15–R-X-19	760	1,600
1945	No. 3 zone, K.1537	4–12	4,214	———	328	4,542
1945	14A zone, K.R.L.13080	14	757	R-X-2–R-X-8	407	1,164
1945	K.R.L.13080	———	2,466	———	———	2,466
1945	K.1537	———	———	———	151	151
Total			17,849	———	2,430	20,279

Some 650 feet of trenching and 24 drillholes explored the shaft zone on K.1541 in 1936. A shaft was sunk to 330 feet during 1937, and in 1937 and 1938 two levels and one sublevel was established.

SURFACE DRILLING IN SHAFT AREA
(Horwood 1945, p. 194)

Hole No.	Width	Grade Gold Per Ton
	feet	ounces
10	2.0	0.20
14	12.16	0.955
18	5.0	0.48
19	5.0	0.57
22	5.0	0.20

UNDERGROUND DEVELOPMENT AND DRILLING
(O.D.M., Vol. XLVII, pt. 1, p. 139)

Level	Development	Number of Drillholes
	feet	
45-foot	245	(1)22
150-foot	360	———
300-foot	370	———

(1) The first 15 holes had a length of 1,720 feet drilled in 1937.

Baird Township

Horwood (1945, p. 194) gives the following description of the results obtained in the mine and of the mineralization:

> None of the lenses indicated by drilling were found . . . on the 150-foot level . . . or on the 300-foot level. Small quartz stringers and zones of carbonate were intersected but, with a few exceptions, they all yielded assays less than 0.07 ounces of gold per ton. A sublevel, at 45 feet below the shaft collar, was reported to have located one lens containing appreciable amounts of gold . . . Data on this lens are not available.
>
> Although three types of mineralization occur in rather erratic distribution in the massive greenstones, no regular zone has been located. Two types, quartz stringers and irregular bands of carbonate are short, lenticular and carry only low values in gold. One assay ran 1.30 ounces but most of the assays were under 0.08 ounces. The third type, which is represented by lenses of silicified rock containing tiny disseminated crystals of arsenopyrite, has yielded good values in gold. Lenses of this material were found near the collar of the shaft, in the shaft 20 feet below the collar, and in 5 surface drillholes. It is also reported from the sublevel. None of the lenses found to date are of sufficient size to make orebodies.

The Camp zone on claim K.1540 has been described as follows by Bishop (1946, p. 7):

> Drilling in the western part of the Camp zone has established the existence of a gold-bearing vein of marginal grade having a length in excess of 70 feet and a number of other intersections . . . The latter intersections probably represent zones that are limited in extent.
>
> In the east half of the Camp zone there is a continuous structure giving rise to quartz and silicification over a distance along the strike of 220 feet. Locally carbonates and carbonatization and the metallic minerals pyrite and arsenopyrite are abundant.

No. 2 zone in the central part of K.1537 has been described by Horwood (1945, p. 194):

> No. 2 zone is a formation of banded cherty sediments with some lean iron formation layers . . . Quartz stringers and some pyrite with associated values in gold have been introduced into the formation, and assays up to 0.18 ounces of gold per ton have been secured. In general the average for the band, which has an average width of about 20 feet, is 0.05 ounces. Trenches were put in for a length of 620 feet, but as the band was offset along many small faults, it was not located definitely beyond the 450-foot mark.

No. 3 zone is located in the northern part of K.1537 and K.R.L.13081. It also consists of cherty sediments, has a maximum width of 15 feet, and has been followed by trenching for 550 feet.

Another zone, called 14A zone, is in the southwestern part of claim K.R.L.13080. This zone was found in 1937 by prospectors employed by Rajah Red Lake Gold Mines Limited. Strongly carbonatized blocks of rock are present between fracture planes. Metallic mineralization is reported (Russell 1937, p. 5) to be mainly pyrite and chalcopyrite with smaller amounts of pyrrhotite, bornite, sphalerite, galena, and arsenopyrite. A grab sample from the oxidized material on surface assayed 5.4 ounces of gold per ton, and a channel sample assayed 1.14 ounces of gold per ton over a length of 5 feet. However, 10 other channel samples gave low values over a length of 240 feet (Russell 1937, assay from No. 14 zone). Hole No. 4 drilled by Rajah Red Lake Mines Limited returned one intersection of 1.12 ounces of gold per ton over a core length of 5 feet, and Bishop (1946, p. 5) observes that "Rajah Red Lake Gold Mines drilled seven holes and obtained several intersections of ore tenor."

Redruth Gold Mines Limited

This company was incorporated in 1944 and holds twenty-one patented claims in Baird township and two adjoining patented claims in Fairlie township. Exploration was carried out from 1944 to 1946 by prospecting, trenching, and 15,000 feet of drilling. Much of the drilling was at closely spaced intervals to

investigate the showings, but cross-sections were drilled on claims K.R.L.18484, 18486, and 20064.

The following description is by Storen (1946, p. 2):

> All the veins in the northern part of the claim group strike east-west and dip to the south. The veins are lenses and quartz stringers in shear zones and fractures. The metallic mineralization is pyrite, pyrrhotite and arsenopyrite and also gold, chalcopyrite, sphalerite and galena. The gold occurs mainly in the free state but also is associated with arsenopyrite.

No. 1 vein is exposed in the northern part of K.R.L.20064 in Fairlie township, and was considered to be the most important of the northern group of veins. Trenching has established the persistence of the vein for 260 feet, and diamond-drilling has extended the length to 700 feet. The dip of the vein ranges from 70°S. in the western part to 55°S. in the eastern part. The width of the vein ranges from 12 to 57 inches, with an average width of 25 inches.

Storen (1946, p. 3) makes the following statement and gives the dimensions and grade:

> No. 1 vein is very erratic, but in 9 of the trenches dug across the vein, 5 have shown free gold and out of 24 diamond-drillholes (including X-ray holes), 5 of them showed free gold in the core.

SECTION SAMPLED

	Length	Width	Cut Grade Per Ton	Gold Per Ton
	feet	inches		ounces
Average of 5 trenches	110	20.5	$17.49	0.454
Average of 6 drillholes	110	22.0	12.62	0.328
Combined average	——	22.0	$14.75	0.383

No. 4 vein is in the northwestern part of claim K.R.L.18486, strikes northwest, and has been explored on surface by sixteen cross-trenches. The Northern Miner (1947b, p. 271) gives the following description of this occurrence:

> Channel sampling on the No. 4 vein returned an average of $20.40 [0.58 ounces of gold per ton] across 8.1 inches for a length of 300 feet, with 25 samples being assayed. Six drillholes put down along this vein returned very low values with hole No. 29, the best, returning $3.15 [0.09 ounces of gold per ton] across 12 inches.

No. 8 vein is in the northern part of claim K.R.L.18486 adjacent to the claim line and has been explored by twelve cross-trenches as well as four drillholes over a length of 348 feet. Two surface samples assayed 0.48 ounces of gold per ton over 10 inches and 0.75 ounces of gold per ton over 18 inches (company plan).

A letter to the shareholders, dated 12 December 1951, advises that scheelite occurs in some carbonate zones and in No. 9 vein, which is on claim K.R.L.18484 south of the creek. The Northern Miner (1952a, p. 74) states that several holes in No. 1 vein have shown scheelite in similar amount to that disclosed in No. 9 vein. In February 1952, E. F. Creelman had completed examination of the drill core and "no significant amount of scheelite was found in the core." (Northern Miner 1952b, p. 179).

Riverdale Gold Mines Limited

This company was incorporated in 1945, and the charter was cancelled in 1957. The property consisted of eight unpatented claims, which were obtained from the Riverdale Prospecting Syndicate. The claim group was on the north side of the township line and west of the New Mallen Red Lake property. In

1945 diamond-drilling was in progress to "test the continuation of the break running through Starratt Olsen and Mallen No. 1 group." (Financial Post Survey of Mines 1946, p. 189). A geological survey was made of the property in 1946, and a magnetic survey was made in 1947.

Russet Red Lake Gold Mines Limited

Russet Red Lake Gold Mines Limited was incorporated in 1936 to take over a group of eight claims formerly held by Russet Red Lake Syndicate. In 1944 the final payment was made to purchase the Cook group of four adjoining claims, located to the north of the original group. The present property consists of fourteen claims.

A great deal of trenching and drilling has been done on the property, but frequently it is impossible to locate the showings from the published descriptions. In 1945 a magnetometer survey was made of the property. No. 1 vein is on K.R.L.12727 and has been traced for 900 feet by stripping and trenching. On K.R.L.12821 four shears, striking east-west and 10 to 21 feet wide, were located. Some of the quartz lenses were mineralized and contained visible gold. On claim K.R.L.19235 some veins and iron formation were located by trenching.

The Northern Miner (1946b, p. 116) gives the following comment on the results obtained in this vicinity:

> Several holes returned encouraging values mainly in quartz. The iron formation has proved disappointing to date and drilling of anomalies indicated by the geophysical survey has shown no promise.

Drillhole No. 82 was collared on the west shore of Russet Lake and intersected silicified tuffs 1,600 feet west of the Madsen boundary (Northern Miner 1947b, p. 48). This tuff zone is reported to strike north and have a known length of 400 feet. Hole No. 87 intersected the tuff and over 8.8 feet gave an average value of 0.524 ounces of gold per ton (Northern Miner 1947a, p. 255).

The following quotation from the Northern Miner (1962, p. 1288) gives a résumé of activities:

> 25,000 feet of cross-sectional drilling done on the north and central sections of the 14-claim property. This work indicated several gold-bearing zones with some intersections that could be classified as ore grade. But these were generally narrow and far from exciting.

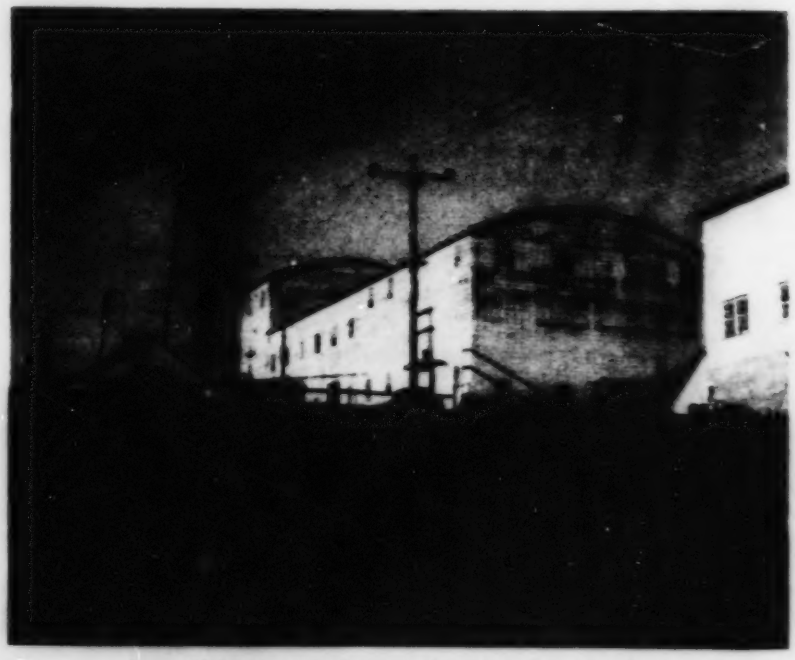
Scheelaur Mines Limited

This company was incorporated in 1951 and dissolved in 1959. A showing on the Campbell–Dome Creek group was uncovered by C. A. Campbell and H. L. Isaacs and Scheelaur Mines Limited, who took over a group of five unpatented claims between the Redruth, Redaurum and Parvus properties. The showing was in a trench on an outcrop immediately west of the trail and 400–500 feet north of the north boundary of K.1539. A sample was taken from each side of the trench and a sample from the bottom of the trench. Each sample represented a length of 40 feet, and assays were 0.33, 0.245, and 0.02 percent tungsten oxide (WO_3) (Financial Post Survey of Mines 1952, p. 347). At the time of the discovery tungsten was quoted at $5.00 per unit, and the above samples had gross values of $21.45, $15.73, and $1.30 per ton. The Northern Miner (1951, p. 1559) reported that an additional discovery was made 40 feet farther north, and spectrographic analyses of grab samples assayed 0.3–0.7 percent tungsten oxide. A small amount of surface drilling was done. (Financial Post Survey of Mines 1955, p. 225). The scheelite occurs in a carbonatized zone containing quartz stringers.

Starratt Nickel Mines Limited[1]

HISTORY AND OWNERSHIP

This property consists of seventeen claims and was first known as the Starratt-Olsen group. The claim group is located southwest of and adjacent to the Madsen property. The ground was first staked in 1926 (Kilgour and de Wet 1948, p. 12), but the claims were allowed to lapse. David Olsen staked part of the group in 1934, and R. W. Starratt and W. Cooke staked the balance of the



Starratt Nickel Mines Limited, watertank, mill and adjacent buildings.

group in 1935. Hollinger Consolidated Gold Mines (Horwood 1945, p. 133) optioned the Olsen group in 1934, and in 1935 Val D'Or Mineral Holdings optioned the Starratt-Olsen group. Faulkenham Lake Gold Mines Limited held an option on the property from Val D'Or Mineral Holdings during 1938 and part of 1939. Hasaga Gold Mines obtained control of the claim group a short time later and renamed the group Hasaga No. 2 property. Starratt-Olsen Gold Mines Limited was incorporated in 1945 to take over the property, although Hasaga Gold Mines retained a 50 percent interest and directed operations. Mas Holdings Limited also held a substantial group of shares (Kilgour and de Wet 1948, p. 12). In March 1957 the company name was changed to Starratt Nickel Mines Limited.

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[1]In 1963 Starratt Nickel Mines Ltd. acquired the eighteen claims previously held by New Faulkenham Mines.

DEVELOPMENT

The Olsen showing is located on claims K.R.L.12643 and 12644 adjacent to the common boundary. Trenching of this showing was done by Hollinger Consolidated Gold Mines in 1934. The following year Val D'Or Mineral Holdings tested the showing with three diamond-drillholes. Horwood (1945, p. 135) gives the following description:

> It is well mineralized with pyrite, contains some quartz, and in 6 trenches, Nos. 1 to 6, at drill hole No. 2, over a length of 85 feet, gave an uncut average of 0.625 ounces of gold per ton across 38 inches. A total of 34 trenches put down over a length of 850 feet, failed to find an extension of the 85-foot shoot. Erratic values were obtained in a few of the trenches. Three drill holes, Nos. 1, 2 and 3 yielded only low values across narrow widths.

DE VILLIER'S SHOWING

The De Villier's showing was named after W. de Villiers a prospector employed by Val D'Or Mineral Holdings (Kilgour and de Wet, 1948, p. 12).

The following description is taken from Horwood (1945, p. 135):

> The De Villier's showing on claims Nos. 12,647 and 12,648 is a shear zone in greenstone containing veins and stringers of quartz. The quartz is a rather massive, greyish-white variety containing a little fine-grained pyrite and in places a little visible gold. The zone has been explored by 21 trenches, Nos. 1 to 19, 26, and 28, and 23 drill-holes, Nos. 7, 9, 10, 13 to 31, and 37, over a length of 2,500 feet. Other trenches and holes have been put in to the southwest and northeast. The following information has been compiled from company plans. Trenches Nos. 8 to 15 explored a length of 420 feet carrying values from 0.05 to 4.10 ounces per ton. If the high values obtained in trenches Nos. 8 and 9 are included, an uncut grade of 0.556 ounces across 26 inches is obtained. But if these high erratics are reduced to the uncut grade for trenches Nos. 10 to 15, a grade of 0.188 ounces results. The 420-foot length was explored by 7 drill-holes. Although holes Nos. 15, 16, and 20 returned intersections that assayed as much as 0.41 ounces, the other holes yielded only low values. The trenches and holes beyond the 420 -foot section located some mineralization, but with one or two exceptions values were very low. A one-compartment test shaft was sunk to a depth of 30 feet on vein quartz during the summer of 1937. The vein was cut off at 15 feet and was not located in a 30-foot crosscut put out to the northwest.

STARRATT SHOWING

The Starratt showing was on claim K.R.L.12730, and at this location the shaft has been sunk to a depth of 2,129 feet, and underground workings established. Faulkenham Gold Mines Limited sank the shaft to 175 feet but relinlinquished the option in March 1939 before a crosscut was driven to the mineralized zone. As the Hasaga No. 2 property, the orebody was explored on the 175-foot level, and the shaft was deepened to allow development on the 300-foot level. The property was idle during part of World War II, but in August 1944 exploration was resumed. Fifty-two drillholes were drilled on the surface with a total length of 21,139 feet over a strike length of 2,000 feet, and an additional 2,600 feet was drilled from underground. Starratt Olsen Gold Mines Limited was formed to continue development. By 1947 the shaft had again been deepened, levels had been established at 550 feet and 800 feet, and it was decided to put the mine into production. A 500-ton-per-day mill and a steel headframe were purchased from Uchi Gold Mines Limited.

About 2,000 tons of mining and milling equipment was hauled 105 miles to the property by bush road and frozen lake during February and March 1948 (Kilgour and de Wet 1948, p. 13). On 1 September 1948 milling began and continued until August 1956 (O.D.M. 1958, p. 83).

MINE DEVELOPMENT
(O. D. M. 1957, pt. 2, p. 83)

Level	Drifts	Crosscuts	Raises
	feet	feet	feet
175-foot	1,845	243	520
300-foot	2,387	609	391
550-foot	2,557	272	1,193
675-foot	357	———	135
800-foot	6,631	86	1,581
1,000-foot	2,758	18	1,832
1,150-foot	6,434	———	1,781
1,325-foot	3,715	———	1,320
1,475-foot	7,278	———	2,132
1,660-foot	28	———	561
1,960-foot	3,983	———	120
Total	37,973	1,228	11,566

General Geology

The Starratt Nickel Mines property is along the strike from Madsen Red Lake Gold Mines, and similar rock types and geological structure exist at the two mines. The country rocks are basalts, tuff, and welded tuff cut by metagabbro and altered peridotite, and by granodiorite of the Killala-Baird batholith and the Faulkenham Lake stock and by late dikes.

The productive zone is in a group of country rocks between the two major granitic intrusions. The basalts on the surface are mainly fine-grained and uniform, with pillows recognized in only one outcrop at 500 feet north of the shaft. Three tuff bands, which are interbedded with the basalts and dikes or sills of basic and ultrabasic rocks, are known from surface drilling and from underground workings. These beds are known as the South tuff, North tuff, and Creek zone tuff. The South tuff is a direct continuation of the Austin tuff at Madsen. Only one outcrop existed for each of the South tuff and Creek zone tuff, and the North tuff was not exposed. The tuff beds underlie a linear depression about 400 feet wide, which formerly was a swampy area but is now partly filled with tailings. The tuffs range in width from 30 to 250 feet and in the core from surface drilling were well-banded and generally contain garnets. They contain finely interbanded, light-coloured, siliceous layers and brownish black biotite layers. Hawley (1946, pp. 9–10) examined five thin sections of the South tuff from drillhole U-391 on the 300-foot level at 1,020 feet southwest of the shaft, and two other sections were examined from U-1009. He describes the tuff as showing rapid variations across the bedding and containing a wide variety of metamorphic silicates. Quartz, biotite, garnet, and feldspar are the most abundant minerals. Some sections contain andalusite, staurolite, diopside, hornblende, an iron-poor hornblende (paragasite), tremolite, epidote, zoisite, muscovite, sericite, chlorite, and minor tourmaline. Nowhere has andalusite completely replaced the earlier minerals, but in places it forms skeletal crystals and in other places contains minute inclusions of biotite and iron oxides.

Some tabular bodies and lenses of rock are called "sheared feldspar porphyry" on the mine plans. Hawley (1946, p. 13) describes these rocks as containing metacrysts of feldspar, some metamorphic pyroxene, and in part hornblende-biotite-quartz schist, similar to some phases of the tuff. Sericite is a prominent alteration mineral in the part of the rock containing porphyroblasts.

The basic intrusive rocks have been described by Hawley (1946, pp. 6–7) as hornblende diorite and serpentinized peridotite. No description of the acidic and minor intrusive rocks is available.

STRUCTURE

The strike of the beds near the shaft is N.55°E., and the dip is 70°–80°SE. No facings of any of the beds is known in the mine area, but the welded tuff is presumed to overlie the basaltic lavas.

On the 800-foot level four faults have been intersected in the workings, 1,300–3,200 feet southwest of the shaft. The "26," "50," and "60" faults strike from N.20°E. to N.30°E., and the "32" strikes at N.40°E. Correlation of these faults from level to level is somewhat uncertain, but the dips appear to be 80°SE. to vertical. The "60" fault is shown on the longitudinal projection as dipping west. Other faults like the Regional fault, "1350," and "1360" faults are shown in longitudinal projection, but the author has no knowledge of the attitude of these faults.

OREBODIES

The ore consists of mineralized lenses within the tuff bed. The Discovery zone consisted of gold-bearing pods of garnetiferous tuff in a basalt flow adjacent to a "diorite" contact. This flow lies between the South tuff and North tuff. The most persistent ore lenses are in the North tuff, and some ore lenses also occur in the Creek zone tuff. These ore lenses extend down the dip but do not show any rake.

ANALYSES OF ORE

Sample No.	Au	Ag	Cu	Fe	S	Insoluble
	ounces per ton		percent	percent	percent	percent
1	0.225	———	0.01	6.38	2.96	78.15
2	0.240	———	0.01	6.25	2.97	77.45
3	0.225	———	0.01	5.59	3.01	79.45
4	0.185	———	0.01	4.90	2.18	75.40
5	0.25	0.07	0.01	5.00	1.48	78.60

Nos. 1–4. Elliott (1951, pp. 3–5), no location given for material sampled.
No. 5. Elliott (1955, pp. 3–4), composite muck sample for 10-day period from 14–70 stope, Creek zone ore.

Elliott (1951, pp. 4–5; 1955, p. 3) and Mines Branch Investigation No. 2568 (1949, p. 3) give a description of the metallic and gangue minerals.

In a superpanner concentrate the minerals in respective order of abundance were pyrite, magnetite, garnet, scheelite, and quartz. A hand specimen and microscopic investigation showed the gangue minerals to consist mainly of quartz, and chlorite with a small amount of carbonate. The quartz and chlorite were very finely and intimately associated, but the relative amounts of each were variable. In other specimens the gangue was found to consist mainly of quartz with minor amounts of epidote, chlorite, and carbonate. Milling difficulties were encountered in handling "muddy tuff" from the hanging wall of 26 orebody above the 1,000-foot level. An iron-rich clay mineral montronite was identified (Elliott 1951, pp. 8–9) from this material.

Pyrite, pyrrhotite, ilmenite, arsenopyrite, chalcopyrite, sphalerite, and gold were the metallic minerals identified. Pyrite is the most abundant ore mineral and occurs as unevenly disseminated crystals about 1 millimetre in diameter. Pyrrhotite is almost as abundant as pyrite and locally is more abundant. It is disseminated in the gangue minerals as irregular particles, which generally are much smaller than the pyrite grains, although a few concentrations up to 1 centimetre in diameter occur. Other metallic minerals are present in very small quantities. Particles of gold were observed in siliceous laminations in the schist as well as in pyrite. Hawley (1946, p. 4) and Mines Branch Investigation No. 2568 (1949) conclude that the gold is not associated with the sulphides to any appreciable extent.

Ore Distribution (Reserves 1948)

(Kilgour and de Wet 1948, p. 13)

Location	Tons	Average Value Per Ton			
		Uncut Grade		Cut Grade[1]	
			ounces		ounces
Surface to 300 feet	50,000	$13.06	0.37	$7.31	0.21
300–500 feet	100,000	14.17	0.40	7.40	0.21
550–800 feet	126,000	9.30	0.27	7.12	0.20
800–1,100 feet	181,000	7.40	0.21	6.50	0.18
Total to 1,100 feet	457,000	10.00	0.29	6.94	0.20
Add dilution	45,000	1.05	0.03	1.05	0.03
Total surface to 1,100 feet	502,700	9.20	0.26	6.43	0.18

[1] In cut grade all values above 1 ounce reduced to that figure.

Locations of Ore Zones, Starratt Showing

(O. D. M. Vol. LXII, pt. 2, p. 74; Vol. LXIII, pt. 2, p. 86; LXIV, pt. 2, p. 83; Vol. LXV, pt. 2, p. 83)

Year	Level	Stope No.	Location Southwest of Shaft	Length	Width	Grade Per Ton		Tonnage Above Level, or Notes
			feet	feet	feet		ounces	
1952	1,325-ft.	13-18..	900–957	57	4.2	$4.09	0.12	6,200 tons
		13-22..	1,056–1,131	75	15.5	6.51	0.19	14,500 tons
		13-26..	1,200–1,383	183	12.5	8.19	0.23	64,000 tons
	1,475-ft.	14-26..	———	—	—	—	—	No orebody.
1953	1,150-ft.	11-50..	2,425–2,510	85	5.0	9.03	0.26	———
	1,475-ft.	14-50..	———	—	—	—	—	Ore begins 70 feet above the level.
		14-54..	2,725–2,815	90	5.4	10.18	0.29	Extensively faulted above the level.
1954	1,475-ft.	14-50..	3,290–3,400	110	6.5	15.37	0.44	Poor vertical continuity.
		14-70..	3,510–3,590	80	5.0	13.60	0.39	
1955	800-ft.	8-50..	2,520–2,600	—	—	—	—	Providing bulk of mill feed for 1955.
	1,150-ft.	11-50..	———	—	—	—	—	

Baird Township

The following extract is from the manager's report for the year ending 31 December 1956 (O.D.M. 1958, pp. 83–84):

Previous to the period under review extensive exploration had failed to locate a continuation of the ore zones below the upper productive levels of the mine. This exploration had been continued to a depth of 500 feet below the deepest productive horizon, with lateral work beyond the the extremities of the favourable area at this depth. Only limited amounts of low-grade material were encountered in this work. Other earlier work consisted of lateral exploration on the upper levels extending to over 4,000 feet west of the shaft. Small amounts of ore were located and subsequently mined in this western section.

A close study of the western section of the mine suggested the possibility of this section entering a more favourable geological condition 2,600 feet west of the shaft, and at a depth of 2,000 feet. To provide a diamond-drill site to test this expected favourable area the bottom level, at a depth of 1,960 feet, was driven 1,516 feet west during 1956. This work was followed up with extensive drilling below the level. Geological conditions were found to be unfavourable, and no mineralization was encountered in this program.

Upon completion of this program, all known zones and the whole of the areas accessible from the mine workings have been thoroughly explored, no prospects remained of finding additional ore.

PRODUCTION OF GOLD AND SILVER FROM THE MINES OF BAIRD TOWNSHIP

Year	Madsen Red Lake Gold Mines Limited		Starratt Nickel Mines Limited	
	Gold	Silver	Gold	Silver
	ounces	ounces	ounces	ounces
1938	9,269	2,209	——	——
1939	26,151	5,955	——	——
1940	29,282	6,324	——	——
1941	31,189	6,856	——	——
1942	38,183	7,647	——	——
1943	34,259	7,507	——	——
1944	37,547	7,673	——	——
1945	25,959	5,590	——	——
1946	29,751	6,741	——	——
1947	32,293	7,754	——	——
1948	35,228	8,286	4,230	691
1949	61,111	12,579	22,382	2,764
1950	65,450	15,022	31,580	5,644
1951	61,680	14,708	24,698	5,024
1952	67,344	14,693	26,239	5,342
1953	82,593	18,157	22,378	4,318
1954	82,344	17,165	14,636	2,379
1955	104,867	19,853	10,811	635
1956	100,989	18,423	7,036	635
1957	103,191	19,310	——	——
1958	123,489	21,656	——	——
1959	118,796	20,401	——	——
1960	119,076	18,575	——	——
1961	106,096	17,126	——	——
1962	100,899	17,481	——	——
Total	1,628,036	317,687	163,990	27,432
Average Recovery Per Ton	0.292	0.05	0.180	0.030

Production, Baird Township

Year	Madsen Red Lake Gold Mines Limited		Starratt Nickel Mines Limited		Total Value
	tons		tons		
1938	44,663	$ 327,827	——	——	$ 327,827
1939	136,929	954,302	——	——	954,302
1940	141,625	1,129,725	——	——	1,129,725
1941	145,995	1,203,311	——	——	1,203,311
1942	146,226	1,473,029	——	——	1,473,029
1943	144,792	1,321,889	——	——	1,321,889
1944	132,759	1,448,533	——	——	1,448,533
1945	101,663	1,001,661	——	——	1,001,661
1946	121,649	1,088,533	——	——	1,088,533
1947	142,136	1,135,793	——	——	1,135,793
1948	151,686	1,239,131	33,501	$ 148,545	1,387,676
1949	233,376	2,226,209	108,030	814,189	3,040,318
1950	282,050	2,496,224	136,801	1,202,286	3,698,510
1951	302,227	2,282,931	151,187	912,853	3,195,784
1952	304,251	2,316,155	155,690	901,468	3,217,623
1953	285,018	2,857,742	159,139	774,608	3,632,350
1954	286,246	2,818,318	99,375	500,888	3,318,206
1955	295,713	3,640,045	64,090	374,561	4,014,606
1956	294,913	3,494,748	——	244,730	3,739,478
1957	305,300	3,486,900	——	——	3,486,900
1958	302,200	4,209,996	——	——	4,209,996
1959	301,999	4,005,890	——	——	4,005,890
1960	306,377	4,059,145	——	——	4,059,145
1961	301,031	3,778,307	——	——	3,778,307
1962	311,705	3,774,632	——	——	3,774,632
Total	5,522,529	$57,537,276	907,813	$5,874,128	63,644,024
Average Recovery Per Ton	——	$10.42	——	$6.47	——

Baird Township

Employees, Wages, and Salaries

Year	Madsen Red Lake Gold Mines Limited		Starratt Nickel Mines Limited	
	Employees	Wages and Salaries	Employees	Wages and Salaries
1938	128	$ 218,617	——	——
1939	166	346,524	——	——
1940	207	374,536	——	——
1941	232	474,512	——	——
1942	177	412,835	——	——
1943	160	346,343	——	——
1944	138	331,243	——	——
1945	139	317,414	——	——
1946	183	439,924	——	——
1947	175	457,976	——	——
1948	240	637,774	139	$ 292,852
1949	306	763,240	150	417,266
1950	264	709,117	140	404,682
1951	256	813,080	145	468,896
1952	298	866,191	138	487,906
1953	288	867,971	116	420,472
1954	304	1,010,000	84	326,928
1955	325	1,104,621	78	309,417
1956	345	1,243,453	75	209,868
1957	374	1,391,348	——	——
1958	361	1,423,259	——	——
1959	377	1,544,639	——	——
1960	410	1,742,284	——	——
1961	425	1,849,157	——	——
1962	411	1,815,590	——	——
Total	——	$21,501,635	——	$3,338,287

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